20492

EBASCO

# REM III PROGRAM

## REMEDIAL PLANNING ACTIVITIES AT SELECTED UNCONTROLLED HAZARDOUS SUBSTANCE DISPOSAL SITES WITHIN EPA REGIONS I-IV

6.8

BASIS OF DESIGN REPORT

BANK PROTECTION CONTROLS
LEES LANE LANDFILL SITE
JEFFERSON COUNTY, KENTUCKY

EPA CONTRACT 68-01-7250

EBASCO SERVICES INCORPORATED

EBASCO SERVICES INCORPORATED
NORCROSS, GEORGIA

# BASIS OF DESIGN REPORT

BANK PROTECTION CONTROLS
LEES LANE LANDFILL SITE
JEFFERSON COUNTY, KENTUCKY

SUBMITTED
TO
UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION IV
ATLANTA, GEORGIA

| Status | Approval Date | Lead Discipline Engineer/ | Reviewed By Supervisor Civil Engineering | Approved By Regional Manager Region IV | Pages Affected |
|---|---|---|---|---|---|
| Original | 9/24/87 | H. Koeplin | K. Kessler | M. A. Szomjassy | |
| R1 | 12/02/87 | H. Koeplin | K. Kessler | M. A. Szomjassy | i,10,11 App. A&B Dwgs. 3&4 |

**EBASCO SERVICES INCORPORATED**

**EBASCO**

145 Technology Park/Atlanta, Norcross, Georgia 30092-2979, (404) 449-5800

September 24, 1987
RMIV-REM-87-445
Response Date: N/A

Ms. Beverly Houston
U. S. Environmental Protection Agency
Region IV
345 Courtland Street, N.E.
Atlanta, Georgia 30365

Dear Ms. Houston:

Subject: REM III - EPA CONTRACT NO. 68-01-7250
W. A. NO. 128-4N43; LEE'S LANE LANDFILL
TRANSMITTAL OF BASIS OF DESIGN REPORT

Enclosed are two copies of the Basis of Design Report for slope protection at the Lee's Lane Landfill. The report contains:

- o Basis of Design
- o Design Calculations
- o Design Drawings and Specifications

Please call Keith Kessler at (404) 662-2215 or me at (404) 662-2378, if you have any questions regarding the report.

Very truly yours,

Michael A. Szomjassy
Regional Manager
Region IV

MAS/KAK/nd
Enclosure

cc: M. K. Yates
M. Amdurer
A. O'Rear
K. Kessler
E. Hatcher (site)
R. Howard (site)
File: LEE

LEES LANE LANDFILL - BASIS OF DESIGN REPORT

TABLE OF CONTENTS

# 1.0 INTRODUCTION

## 1.0 INTRODUCTION

Ebasco REM III Team has prepared this Basis of Design (BOD) Report for the design of the Bank Protection Control for the Lees Lane Landfill. The Site is located in an area adjacent to Ohio River in Jefferson County, approximately 4.4 miles southwest of Louisville, Kentucky. The Bank Protection Control is part of Alternative 3 (a total of 6 alternatives were defined) in the "Final Remedial Investigation and Feasibility Study of Alternatives, Lees Lane Landfill Site, Jefferson County, Kentucky, EPA WA No. 46-4L43."

This submittal has been prepared for the United States Environmental Protection Agency (USEPA) Region IV under work assignment Number 128-4N43, EPA Contract Number 68-01-7250.

Following this introduction, the report is presented in three major sections:

- Section 2.0 is the "Basis of Design." The section begins with a discussion of the requirements of the "Enforcement Decision Document." This subsection includes the objective of the design and the approach to the design. The remaining subsections describe in detail the criteria and data that form the basis for the selection and design of the filter blanket, riprap for bank protection, and the stability analysis for the bank slope. Also included is a discussion of the riprap limits and other miscellaneous design considerations. The final subsection notes exceptions to the design as recorded during the design phase.

- Appendix A contains the "Design Calculations." Calculations were prepared for sizing the filter material and riprap and for analyzing the stability of the river bank slope.

- Appendix B contains the "Final Design." The design documents consist of the earthwork specification and the design drawings.

# 2.0 BASIS OF DESIGN

## 2.0 BASIS OF DESIGN (BOD)

This Basis of Design (BOD) report presents the details that include the criteria, methodology, and data source for the design of the Bank Protection Control.

A major data source for the BOD was the feasibility report entitled "Final Remedial Investigation and Feasibility Study of Alternatives, Lees Lane Landfill Site, Jefferson County, Kentucky, EPA WA No. 46-4L43", (hereinafter termed Feasibility Study Report). Other data included state and federal guides and input from the local U.S. Corps of Engineers (through the Emergency Response and Control Section). Site-specific data included an aerial and land survey, soil and rock grain size distribution curves, and on-site test sections.

Specific references are presented with the appropriate design calculations.

### 2.1 Enforcement Decision Document

A final Enforcement Decision Document (EDD) documenting the rationale for selection of Alternative 3 (one of six alternatives considered) as the preferred remedial measure was signed by the EPA Regional Administrator for Region IV on September 25, 1986.

As described in the EDD, the selected remedy includes the following seven work items:

1. Provision for a properly operating gas-collection system.
2. Consideration of a possible future alternate water supply.
3. Cleanup of surface waste areas.
4. Bank protection controls.
5. Establishment of Alternate Concentration Limits (ACL) for the groundwater at the site.

6. Institutional controls, which will be fully identified during remedial design, will be implemented. These controls may include, but will not be limited to:
   a. cautionary signs
   b. installation of a gate at the Putnam Street access point

7. Operation and Maintenance (O&M) activities which will include:
   a. groundwater, gas, and air monitoring
   b. periodic inspection of the gas monitoring wells, gas collection system, capped waste areas, and the riprap along the Ohio River bank.

This BOD Report addresses the work items as described in the EDD, Item No. 4, Bank Protection Control, for which Ebasco Services Incorporated performed engineering, analysis, and design. The report specifically identifies the basis of design for the bank protection control system.

2.1.1 Remedial Design Objective

The objective of the bank protection design is to provide a stable bank adjacent to the landfill. The stable river bank is necessary to prevent slope erosion which would encroach on the landfill.

2.1.2 Remedial Design Approach

In order to support the construction efforts of the EPA Emergency Response and Control Section (ERCS), the remedial design was performed during the initial phases of construction. The design was, therefore, closely coordinated with the ERCS. Significant input to the design was provided through the ERCS by sources such as the U.S. Corps of Engineers. Coordination with the ERCS was primarily provided by assigning an Ebasco design

engineer to the project site. As the conceptual design was developed, detailed analysis was performed in Ebasco's offices in order to verify and finalize the design. The analyses consisted of slope stability studies and analysis and design of the filter blanket and riprap river bank protection.

## 2.2 Establishment of Riprap Limits

In the Feasibility Study Report, the Landfill Site had been divided into three tracts: the Northern tract, the Central tract and the Southern Tract. The initial effort in defining riprap limits was to observe test pits in each tract. From the test pits, it was determined that there was little, if any, landfill material in the northern tract. The landfill material was found to be concentrated in the central tract with some encroachment on to the southern tract. Additional site investigation indicated the following:

- Landfill material was observed on the river bank in the central tract.
- The Landfill material observed in the southern tract was set back from the river bank.
- The trees and vegetation in the northern and southern tract were larger and more established than in the central tract.
- The drainage feature between the southern and central tract provides a natural break between the tracts.

Based on this information, with no visual evidence of land fill material close to the river banks at the northern and southern tracts and the indication of established mature vegetation in these two regions, it was decided to limit the horizontal extent of the riprap to the boundaries of the central tract.

Apparent erosion on the river bank of the southern tract will require appropriate periodic inspection and monitoring and is addressed in the operation and maintenance plan for the project.

The upper limit of the riprap was set at the approximate natural crest of the river bank slope. As the project site grading continued and the new embankment slopes were established, the existing river bank crest leveled at nominal elevation 440 ft (Mean Sea Level) as observed by the design engineer.

The lower limit of the riprap was established with a four feet thick layer of the larger riprap on the river bank slope extending 10 to 15 feet out from the waterline at the river bank. Input was obtained from the U.S. Army Corps of Engineers to determine this limit. This limit was based on the normal river pool elevation.

## 2.3 Riprap and Filter Blanket Design for Bank Protection

The design criteria for the filter blanket and riprap design was based on federal and state standards and local experience. These standards and practices deemed applicable are listed as follows:

Federal

- U.S. Army Corps of Engineers, Engineering Manual, Part XIII, Chapter 2

- U.S. Army Corps of Engineers, Waterways Experiment Station, Technical Memorandum No. 183-1

- U.S. Bureau of Reclamation, "Design of Small Dams"

- U.S. Department of Transportation, "Hydraulic Engineering," Circular No. 11

State

- Kentucky Department of Transportation, Bureau of Highways Frankfort Standard Specifications for Road and Bridge Construction

Others

- Harry R Cedergren, "Seepage, Drainage and Flownet," John Wiley and Sons, Inc.

- James L Sherand, Richard J Woodward, Stanley F Gizienski, "Earth and Earth-Rock Dams," John Wiley and Sons, Inc.

- George B Sowers and George F Sowers, "Introductory Soil Mechanics and Foundations," MacMillan Publish Co.

- William A Cutter, Robert C Waterman, "Riprap Design for the Ohio River," Proceeding of 15th Ohio River Valley Soils Seminar.

- Grain size distribution test results by Law Engineering and NUS Corporation for Lee's Lane Landfill Site, Jefferson County, Kentucky.

The riprap design was performed in accordance with the following criteria:

- Mean flow velocity based on the 100-year flood condition of the Ohio River at the City of Louisville, Kentucky

- Size of riprap was determined by the relationship of the mean velocity against the stone, the ratio of 50 percent stone size to the depth of flow and the unit weight of stone. The riprap sizing followed the procedure as stipulated in "Hydraulic Engineering Circular No. 11, U.S. Department of Transportation

- The design of the filter blanket for riprap was performed in accordance with the following criteria:

| | Criterion | Sources |
|---|---|---|
| (1) | $\frac{D15 \text{ (filter material)}}{D85 \text{ (protected soil)}} \leq 5$ | U.S. Army Corp of Engineers<br>U.S. Dept of Transportation<br>Cedergren<br>Sowers |
| (2) | $\frac{D15 \text{ (filter material)}}{D15 \text{ (protected soil)}} \geq 5$ | Cedergren<br>Sowers |
| (3) | $\frac{D50 \text{ (filter material)}}{D50 \text{ (protected soil)}} \leq 25$ | Cedergren |

## 2.4 Stability Analysis for River Bank Slope

The conventional static Simplified Bishop slip-circle stability analysis was performed for the river bank slope stability to investigate its long- term and short-term performance of the slope. The soil parameters used for long term stability analysis were based on the drained shear strength of the subsoil materials. Undrained shear strength was used for the short-term stability analysis.

The criteria for minimum acceptable factors of safety used were as follows:

| Minimum Factor of Safety | Model Conditions |
|---|---|
| 1.5 | Long-term Static |
| 1.3 | Short-term Static |

The model and parameters used for the Slope Stability analysis were based on the following sources of information:

- "Topographic Survey Map," by Horne Engineering Inc. of Nicholasville, Kentucky, July 1987

- "Foundation Analysis and Design," J E Bowles, McGraw Hill Book Co.

- "Final Remedial Investigation and Feasibility Study of Alternatives, Lees Lane Landfill Site, Jefferson County, Kentucky," Vol. I, II & III, April, 1986

  - o Figure 3-7 "Landfill Boundary"
  - o Figure 3-9 "Area Used to Calculate Fill Volume"
  - o Figure 4-1 "Boring Location"
  - o Figure 4-3 "Cross Section 1-4 & 1-3"
  - o Figure 4-4 "Cross Section MW-02 & MW-05"
  - o Figure 4-5 "Fence Diagram"
  - o Table 3-2 "Areas & Depth Values Used to Calculate Waste Volume"
  - o Table 4-3 "Ground Water Elevations"

The analysis was performed using an Ebasco in-house computer program (STABR), Ebasco Services Incorporated, calculation index, Calc. No. 4, slope stability analysis and computer output.

In performing the slip-circle slope stability analysis, a circular failure surface was assumed, and the portion of the circle through the slope was first divided into vertical slices. Then the tangential resisting and driving forces along the circular surface were computed for each slice. The factor of safety against rotational sliding was computed as the ratio of the sum of the resisting moments taken about the center of rotation to the sum of the driving moments about the same center of rotation.

To find the worst possible radius and center of rotation yielding the circle with the lowest factor of safety, a search routine was used in which a trail center of rotation is selected using different radii to compute each safety factor. The center of rotation was programmed to move at a prescribed increment to a different trial location, and the above process was repeated until the lowest safety factor was obtained.

The results and the obtained safety factors for the slope stability analysis for higher and lower soil properties are documented on Sheet 4 of 6 of the Lee's Lane Landfill Slope Stability Analysis, Ebasco Services Incorporated Calculation Index, Calc. No. 4.

## 2.5 Miscellaneous Design Considerations

### 2.5.1 Riprap Layer Thickness

The sizing of the filter blanket and riprap materials has been discussed in previous sections, however, the thickness of each layer requires additional consideration. It is generally accepted, however, that the minimum thickness of the riprap layer shall not be less than twice the maximum particle size. Greater layer thicknesses may be specified when the site condition or placement techniques require additional material to ensure the minimum coverage. The design drawing (Drawing No. E-4236-D-1), sheet 5 of 7 shows typical sections and details of the river bank protection system and identifies the riprap layer thickness with 16 to 20 inches. (Twice the normal particle size).

### 2.5.2 Filter Fabric

The filter fabric used in the river bank protection system prevents migration of manufactured sand into the No. 3 stone. The main purpose of the fabric, however, is to provide a stable working surface for the placement of the overlying stone. The selection of Supac 4NP was the result of an on-site test performed July 7, 1987. Anchoring the filter fabric in a perimeter trench is a standard installation detail. The daily logs completed by the on-site Design Engineer, provided under separate cover, details the results of this test.

2.5.3 Riprap Toe

At the toe of the riprap section, the finer sand and rock layers were discontinued with the thickness of the larger riprap stone increased to four feet. This heavier section extends 10 to 15 feet into the river bed and forms a base for the riprap slope.

2.5.4 Edge of Riprap

At the upstream and downstream edges of the riprap slope, the finer sand and stone layers are truncated at grade by the larger riprap stone extending below grade (see detail on Drawing No. E-4236-D-1, sheet 5 of 7). The purpose of this detail is to prevent erosion of natural soil at the edge of the riprap.

2.5.5 Top of Slope

Broken shale was used in the design at the crest of the river bank slope protection system. This feature was added (and later deleted) at the request of the ERCS.

R1

# APPENDIX A
# DESIGN CALCULATIONS

EBASCO SERVICES INCORPORATED

CALCULATION INDEX

Client: ENVIRONMENTAL PROTECTION AGENCY

Project: LEE'S LANE LANDFILL, JEFFERSON COUNTY, KENTUCKY.

Job No: PROJECT I.D. E-4236

| Calc No. | Rev No. | Subject | Status P=Prelim F=Final | Design Calc's By | Design Calc's Date | Checked By | Date |
|---|---|---|---|---|---|---|---|
| 1 | 1 | SIZING OF RIP-RAP FOR BANK | | | | | |
| | | EROSION PROTECTION | F | P.KH. LIU | 6/17/87 | K. KESSLER | 6/22/87 |
| 2 | 1 | ANALYSIS GRAPH OF GRANULAR MAT'L's | F | P.KH. LIU | 6/17/87 | K. KESSLER | 6/22/87 |
| 3 | 1 | GRAIN SIZE DISTRIBUTION CURVES FOR | F | | | | |
| | | ROCK CONSIDERED FOR DRAINAGE LAYERS | F | SOURCE: ENVIRONMENTAL SCIENCE & ENG'G. INC. | | | |
| 4 | 1 | SLOPE STABILITY ANALYSIS & ATTACHMTS | F | WSL | 7/17/87 | P.KH. LIU | 7/17/87 |
| 5 | 1 | SOIL SAMPLE DATA, SIEVE ANALYSIS | F | LAW ENGINEERING | | | |
| 6 | 1 | GRAIN SIZE ANALYSIS & ATTERBURG LIMITS | F | NUS CORPORATION | | | 5/27/87 |
| 7 | 1 | REPORT OF GRAIN SIZE TEST RESULTS | F | LAW ENGINEERING | | | 6/24/87 |
| | | | | | | | |
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EBASCO SERVICES INCORPORATED

CALCULATION COVER SHEET

CLIENT: ENVIRONMENTAL PROTECTION AGENCY

PROJECT: LEE'S LANE LANDFILL, JEFFERSON COUNTY, KENTUCKY

SUBJECT: SIZING OF RIP-RAP FOR BANK EROSION PROTECTION

OFS. NO. 4236.721 DEPT. 503

CALCULATION NO. 1 NUMBER OF SHEETS 12 ~~10~~ (including this sheet)

WHITAKER C 10-5-87 | R1

SUPERSEDES CALC. NO. N/A

| REV. NO. | REVISION DESCRIPTION | CALC BY Name /Date | CHECKED BY Name /Date |
|---|---|---|---|
| 0 | NOT APPLICABLE | P.K.H LIU 6/17/87 | K. Kessler K. KESSLER 6/22/87 |
| 1 | ADDED TABLE OF CONTENTS (SH 1A); ADDED SUMMARY OF CALC RESULTS (SH 9A); ADDED SIGNATURES FOR REV 0. | M. Dumani 10/12/87 | K. Kessler 10/13/87 |
| 2 | Revised Filter Design analysis for Manufactured Sand Vs Filter Sand and Filter Sand Vs Site Soils. Added Grain Size Curve for Filter Sand used at Site. | M. Dumani 11-17-87 | K. Kessler 11/18/87 |
| | | | |

* FULL SIGNATURE (FIRST NAME, INITIAL AND LAST NAME)

**EBASCO SERVICES INCORPORATED**

BY CAW DATE 10-5-87 SHEET 1A OF 9

CHKD. BY M. Dunnigate 10-10-87 OFS NO. 4236.721 DEPT. NO. 503/941

CLIENT EPA

PROJECT LEE'S LANE LANDFILL, JEFFERSON COUNTY, KENTUCKY

SUBJECT SIZING OF RIP-RAP FOR BANK EROSION PROTECTION

# TABLE OF CONTENTS



R1

* THE DESIGN CRITERIA DOCUMENT FOR THIS PROJECT IS PROVIDED UNDER SEPARATE COVER.

**EBASCO SERVICES INCORPORATED**

BY PKHLIU DATE 6/16/87 SHEET 1 OF 9

CHKD. BY KAK DATE 6/22/87 OFS NO. _____ DEPT. NO. _____

CLIENT EPA

PROJECT LEES LANE LANDFILL

SUBJECT SIZING OF RIPRAP FOR BANK EROSION PROTECTION

REFERENCES :


(1) "Riprap Design for Ohio River : A Change in Philosophy From Big Stone to Positive Bank Drainage", Proceeding of 15th Ohio River Valley Soils Seminar, Nov 2 1984

(2) "Use of Riprap for Bank Protection" Hydraulic Engineering Circular No. 11, US Department of Transportation, Federal Highway Administration Bureau of Public Road, June 1967.

(3) "Seepage, Drainage and Flow Nets", Harry Cedergren. 2nd Edition, John Wiley & Son, Inc. 1977

(4) "Introductory Soil Mechanics & Foundations, by G.B. Sowers & G.F. Sowers, 3rd Edition, MacMillan Publish Co. 1970.

(5) Grain Size Distribution Test Results by NUS Corporation. for Lees Lane Landfill Superfund site, 5/22/87

**EBASCO SERVICES INCORPORATED**

BY P KH LIU DATE 6/16/87 SHEET 2 OF 9

CHKD. BY KHK DATE 6/22/87 OFS NO. DEPT. NO.

CLIENT EPA

PROJECT Lees Lane Landfill

SUBJECT Sizing of Riprap

Note : A telephone call was made to Mr. Ron Evaldi of US Geological Survey, Water Resource Division (Tel 502-582-5241) to acquire the relevant Ohio River flow velocity. Particularly river velocity of 100 yr flood is of special interest for the riprap design

Mr Evaldi stated that they have the following Velocity measurement from the station along Ohio River. o City of Louisville

| | Flow Volume (CFS) | Flow (Mean) Velocity (FPS) |
|---|---|---|
| | 828,000 | 4.4 |
| | 908,000 | 4.6 |
| | 1,000,100 * | 4.8 |
| 100 Yr Flood | 862,000 | ( Estimated 4.7 ) |

No record has been obtained for the 100 yr Flood However, for our design purpose, the interpretation made from existing information, a mean velocity of 4.7 FPS for the 100 yr flood is judged to be reasonable.

* Record Flow measured in 1937

Using Reference NO. 2

$K/d = 0.4$ for depth of flow > 10 ft (P. II-4 ref. 2)

K : stone diameter - ft
d : Depth of flow - ft

From Figure 1 of P II-5 Ref. 2

$K/d = 0.4 \longrightarrow \frac{V_s}{V} = 0.725$

$V_s$ : Velocity against stone - FPS
V : Mean Velocity of flow FPS (use 4.7 fps)

$\frac{V_s}{V} = 0.725$

$V_s = (0.725)(4.7) = 3.4075$ FPS

P. II-5 Ref. 2 recommends $V_s$ should be increased by 22% for sizing of riprap using Fig. 2 of P II-6. ref. 2

$V_s = (3.4075)(1.22) = 4.157$ FPS

For $V_s = 4.157$ & side slope of 3.5 (Horizontal) & 1 (Vertical) Figure 2 of Ref. 2 Obtained stone diameter of approx 0.34 ft or 4.08 inches (Based on $\gamma = 165$ pcf stone)

Correction should be made for other density of stone An average density of $\gamma = 140$ pcf is used for size adjustment

**EBASCO SERVICES INCORPORATED**

BY PKH LIU DATE 6/16/87 SHEET 4 OF 9

CHKD. BY MK DATE 6/22/87 OFS NO. DEPT. NO.

CLIENT EPA

PROJECT Lees Lane Landfill

SUBJECT Sizing of Riprap

Correction of stone size is made using Creager's equation

$$Kw = \frac{102.5\ K}{W - 62.5}$$

Kw = stone size for W density

K = stone size as obtained from Fig 2.

W: Density of stone in PCF

$$Kw = \frac{(102.5 \times 0.34)}{140 - 62.5} = 0.45^{ft} = 5.39^{inches}$$

(50% size of Riprap)

Gradation of Riprap

| | |
|---|---|
| Max. size | 8" |
| 50% size | 5.39" |
| Min size | 4" |

**EBASCO SERVICES INCORPORATED**

BY PKH LIU DATE 6/16/87 SHEET 5 OF 9

CHKD. BY LJK DATE 6/22/87 OFS NO. DEPT. NO.

CLIENT EPA

PROJECT Lees Lane Landfill

SUBJECT Erosion Protection Filter sand / site soils

Criterion for drainage filter design should satisfy the following equations:

(1) $\frac{D_{15\ (Filter\ sand)}}{D_{85\ (site\ soils)}} \leq 5$

Reference Sources

Ref 2 of Fed. Highway Administration
Ref 3 of Cedergren
Ref 4 of Sowers & Sowers

(2) $\frac{D_{15\ (Filter\ sand)}}{D_{15\ (site\ soils)}} \geq 5$

Ref 3 of Cedergren
Ref 4 of Sowers & Sowers

(3) $\frac{D_{50\ (Filter\ sand)}}{D_{50\ (site\ soil}} \leq 25$

Ref 3 of Cedegren

The above criterion is applicable for all other filtering material design ie Riprap / No 3 stone

No. 3 stone / Manufacture sand

Manufacture sand / Filter sand

**EBASCO SERVICES INCORPORATED**

BY PKH LIU DATE 6/17/87 SHEET 6 OF 9

CHKD. BY KHK DATE 6/22/87 OFS NO. DEPT. NO.

CLIENT EPA

PROJECT Lees Lane Landfill

SUBJECT Erosion Protection Riprap / # 3 stone & #3 stone / Man. Sand

## Riprap / # 3 stone

$$\frac{D_{15}\ \text{Riprap}}{D_{85}\ \#3\ \text{stone}} = \frac{120}{45} = 2.66 \quad < 5 \quad \text{OK}$$

$$\frac{D_{15}\ \text{Riprap}}{D_{15}\ \#3\ \text{stone}} = \frac{120}{22} = 5.45 \quad > 5 \quad \text{OK}$$

$$\frac{D_{50}\ \text{Riprap}}{D_{50}\ \#3\ \text{stone}} = \frac{135}{40} = 3.375 \quad < 25 \quad \text{OK}$$

## # 3 stone / Manufactured sand

$$\frac{D_{15}\ \#3\ \text{stone}}{D_{85}\ \text{Man Sand}} = \frac{22}{4} = 5.5 \quad \text{Supposed to be} \leq 5$$

Marginal. Recommend Geotextile to be placed between # 3 stone & Man. Sand

$$\frac{D_{15}\ \#3\ \text{stone}}{D_{15}\ \text{Man. Sand}} = \frac{22}{0.25} = 88 \quad 75 \quad \text{OK}$$

$$\frac{D_{50}\ \#3\ \text{stone}}{D_{50}\ \text{Man. Sand}} = \frac{40}{2.6} = 15.38 \quad < 25 \quad \text{OK.}$$

**EBASCO SERVICES INCORPORATED**

BY PKH LIU DATE 6/16/87 Rev: 2 By M.D 11-17-87 SHEET 7 OF 9
CHKD. BY KJK DATE 6/22/87 Chkd K.K. 11-18-87 OFS NO. DEPT. NO.
CLIENT EPA
PROJECT Lees Lane Landfill
SUBJECT Erosion Protection Filter sand / Site soils

$$\frac{D_{15\,(Filter\,sand)}}{D_{85\,(site\,soils)}} = \frac{0.05}{0.2} = 0.25 < 5 \quad OK \quad R2$$

$$\frac{D_{15\,(Filter\,sand)}}{D_{15\,(site\,soil)}} = \frac{0.005}{0.0018} = 27.7 > 5 \quad OK \quad R2$$

$$\frac{D_{50\,(Filter\,sand)}}{D_{50\,(site\,soil)}} = \frac{0.32}{0.038} = 8.42 < 25 \quad OK \quad R2$$

$$\frac{D_{15(Manufactured\,Sand)}}{D_{85(Filter\,sands)}} = \frac{.25}{.45} = 0.56 < 5 \therefore OK$$

$$\frac{D_{15(Man.\,Sand)}}{D_{15(Filter\,Sand)}} = \frac{.25}{.05} = 5 \leq 5 \therefore OK \quad R2$$

$$\frac{D_{50\,(Manf.\,Sand)}}{D_{50(Filter\,Sand)}} = \frac{2.6}{.32} = 8.125 < 25 \therefore OK$$

Note: Grain Sizes for Filter Sand used in the analyses above are based on envelope of 7 samples representative of material used actually on Site. (See page No. 9B)

581/8-81

**EBASCO SERVICES INCORPORATED**

BY PKH LIU DATE 6/17/87 SHEET 8 OF 9

CHKD. BY KAK DATE 6/22/87 OFS NO. DEPT. NO.

CLIENT EPA

PROJECT Lees Lane Landfill

SUBJECT Gradation/ Grainsize Distribution of Riprap, #3 stone Manufactured Sand & Filter sand

Riprap (4" to 8")

#3 stone

| Size | % Passing |
|---|---|
| 2½" | 100 |
| 2" | 95 - 100 |
| 1½" | 35 - 70 |
| 1" | 0 - 15 |
| ½" | 0 - 15 |

Manufactured Sand

| Size | % Passing |
|---|---|
| 3/4 | 100 |
| 3/8 | 98 |
| #4 | 90 |
| #10 | 40 |
| #20 | 15 |
| #40 | 9 |
| #100 | 3 |
| #200 | 1 |

**EBASCO SERVICES INCORPORATED**

BY PKHLIU DATE 6/16/87 REV 2 BY M.D 12-1-87 SHEET 9 OF 9
CHKD. BY KAK DATE 6/22/87 CHECK K.K 12-2-87 OFS NO. DEPT. NO.
CLIENT EPA
PROJECT Lees Lane Landfill
SUBJECT Gradation / Grain Size Distribution (Contd)

Filter Sands

| Size | % Passing |
|---|---|
| #8 | 100 |
| #16 | 98 |
| #30 | 95 |
| #50 | 85 |
| #100 | 25 |
| #200 | 20 |

R-2

## SUMMARY OF CALCULATION RESULTS:

1) STONE DIAMETER = 4.08" ( Ref. page 3)

2) CORRECTED STONE SIZE = 5.39" ( Ref. Page 4)

3) Drainage filer conforms to the design criteria ( Ref. Page 5)

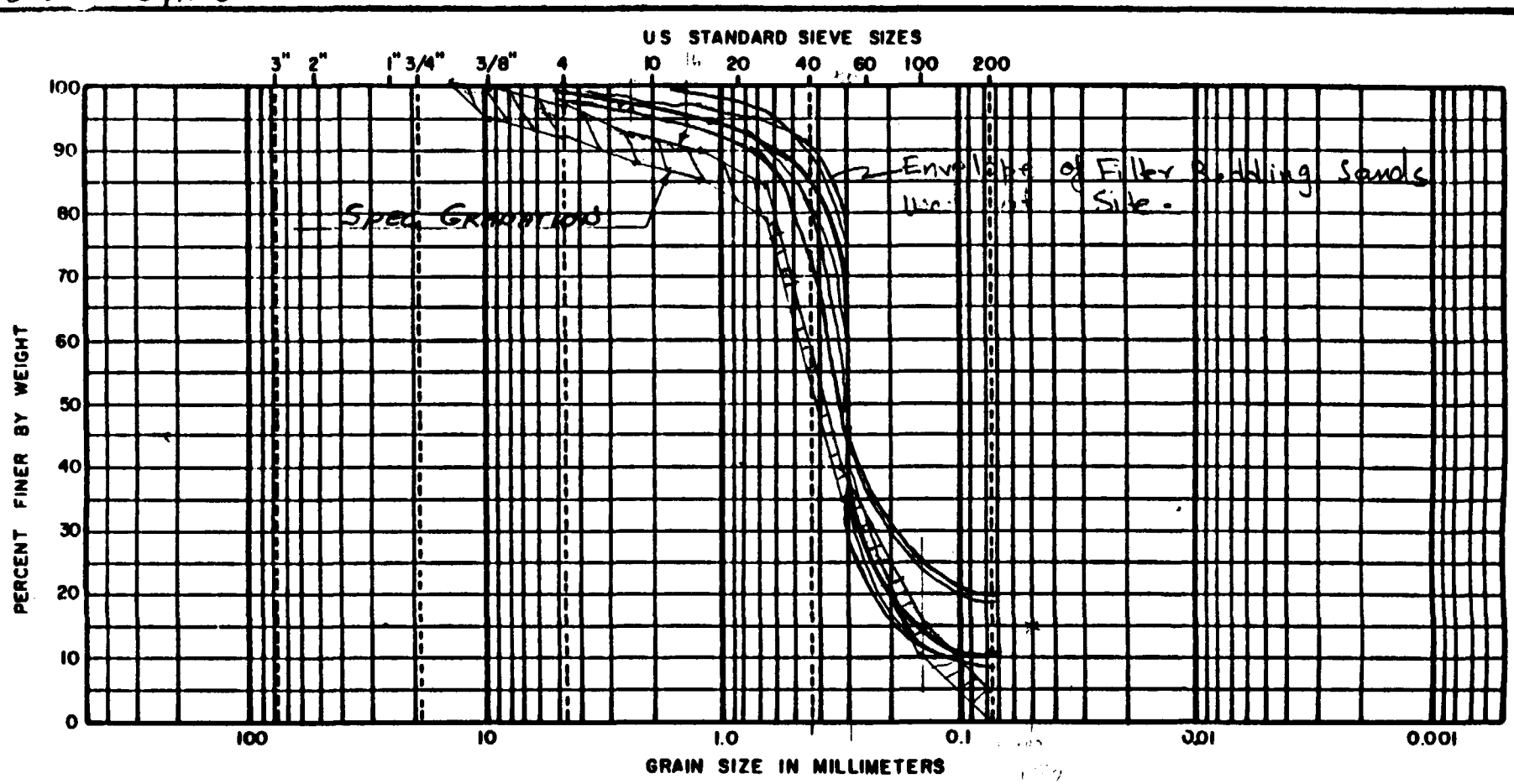
4) Rip-rap / # 3 Stone conforms to the design criteria ( Ref. page 6)

5) # 3 STONE & Manufactured Sand Conforms to the design Criteria ( Ref. page 6)

6) Filter Sand & Site Soils Conforms to the filter design Criteria (Ref. page 7)

RI

LEL LANE




| BOULDERS | COBBLES | GRAVEL | | SAND | | | FINES | |
|---|---|---|---|---|---|---|---|---|
| | | COARSE | FINE | COARSE | MEDIUM | FINE | SILT SIZES | CLAY SIZES |

| | | |
|---|---|---|
| BORING NO. | Bag Sample 1 | DESCRIPTION OR CLASSIFICATION |
| DEPTH OR ELEV. | | Dark Brown Slightly Silty Sand |
| MOISTURE % | 7.0 | * - Composite of 7 samples Tested |
| LIQUID LIMIT | | |
| PLASTIC LIMIT | | |
| PLASTICITY INDEX | | |

**GRAIN SIZE DISTRIBUTION**

JOB NO. 705.87.502

LAW ENGINEERING TESTING COMPANY

Filter Bedding Sand : $D_{15} = .052$; $D_{50} = 0.32$ ; $D_{85} = 0.45$
(Above grain sizes based on envelope of seven samples used at Site as indicated above)

Page 9-B / Rev. 2

FILTER DESIGN

PROJECT: Lees Land Fill (EPA) JOB NO:

INPUT DATA:

| Layer Code | D15 | D85 | D50 | Layer Desciption |
|---|---|---|---|---|
| A | 120 | 0 | 135 | Rip Rap |
| B | 22 | 45 | 40 | # 3 Stone |
| C | .25 | 4 | 2.6 | Manufactured Sand |
| D | .05 | .45 | .32 | Filter Sand |
| E | .0018 | .2 | .038 | Site Soils |

FILTER DESIGN CRITERIA:
-D15 of upper layer divided by D85 of lower layer should be equal or less than 5
C2-D15 of the upper layer divided by D 5 of lower layer should be equal or greater than 5
C3-D50 of the upper layer divided by the D50 of the lower layer should be equal or less than 25

CALCULATIONS:

| Layers | C1 | C2 | C3 | Remarks |
|---|---|---|---|---|
| A/B | 2.666667 | 5.454545 | 3.375 | |
| B/C | 5.5 | 88 | 15.38462 | |
| C/D | .5555556 | 5 | 8.125 | |
| D/E | .25 | 27.77778 | 3.421053 | |

REMARKS: C1 for B/C layer exceeds criteria.Provide a filter fabric between layers B & C.

CONCLUSION: Design Criteria SATISFIED

EBASCO SERVICES INCORPORATED

CALCULATION COVER SHEET

CLIENT: EPA

PROJECT: LEE'S LANE LANDFILL, JEFFERSON COUNTY, KENTUCKY

SUBJECT: ANALYSIS GRAPH OF GRANULAR MATERIALS

OFS. NO. 4236.721 DEPT. 503

CALCULATION NO. 2 NUMBER OF SHEETS 4 (including this sheet)

WHITAKER C. 10-5-87

SUPERSEDES CALC. NO. N/A

| REV. NO. | REVISION DESCRIPTION | CALC BY Name /Date | CHECKED BY Name /Date |
|---|---|---|---|
| 0 | NOT APPLICABLE | P. LIU 6/16/87 | K. KESSLER 6/22/87 |
| 1 | ADDED: TABLE OF CONTENTS (SH 1); BASIS OF DESIGN DATA DEVELOPMENT (SH 2); SIGNATURE FOR REV. 0; PAGE NUMBERS | M. Durrani 10/12/87 | K. Kessler 10/13/87 |
| | | | |
| | | | |

* FULL SIGNATURE (FIRST NAME, INITIAL AND LAST NAME)

**EBASCO SERVICES INCORPORATED**

BY CAW DATE 10-5-87 SHEET 1 OF 3

CHKD. BY MD DATE 10-12-87 OFS NO. 4236.721 DEPT. NO. 503/941

CLIENT EPA

PROJECT LEE'S LANE LANDFILL, JEFFERSON COUNTY, KENTUCKY

SUBJECT ANALYSIS GRAPH OF GRANULAR MATERIALS

# TABLE OF CONTENTS



THE DESIGN CRITERIA DOCUMENT FOR THIS PROJECT IS PROVIDED UNDER SEPARATE COVER.

EBASCO SERVICES INCORPORATED

BY M. Durrani DATE 10/12/87 SHEET 2 OF 3

CHKD. BY K. Thacker DATE 10/13/87 OFS NO. _____ DEPT. NO. 503

CLIENT EPA

PROJECT LEE'S LAND LANDFILL

SUBJECT Grainsize of Slope Protection Materials.

## BASIS OF DESIGN DEVELOPMENT:

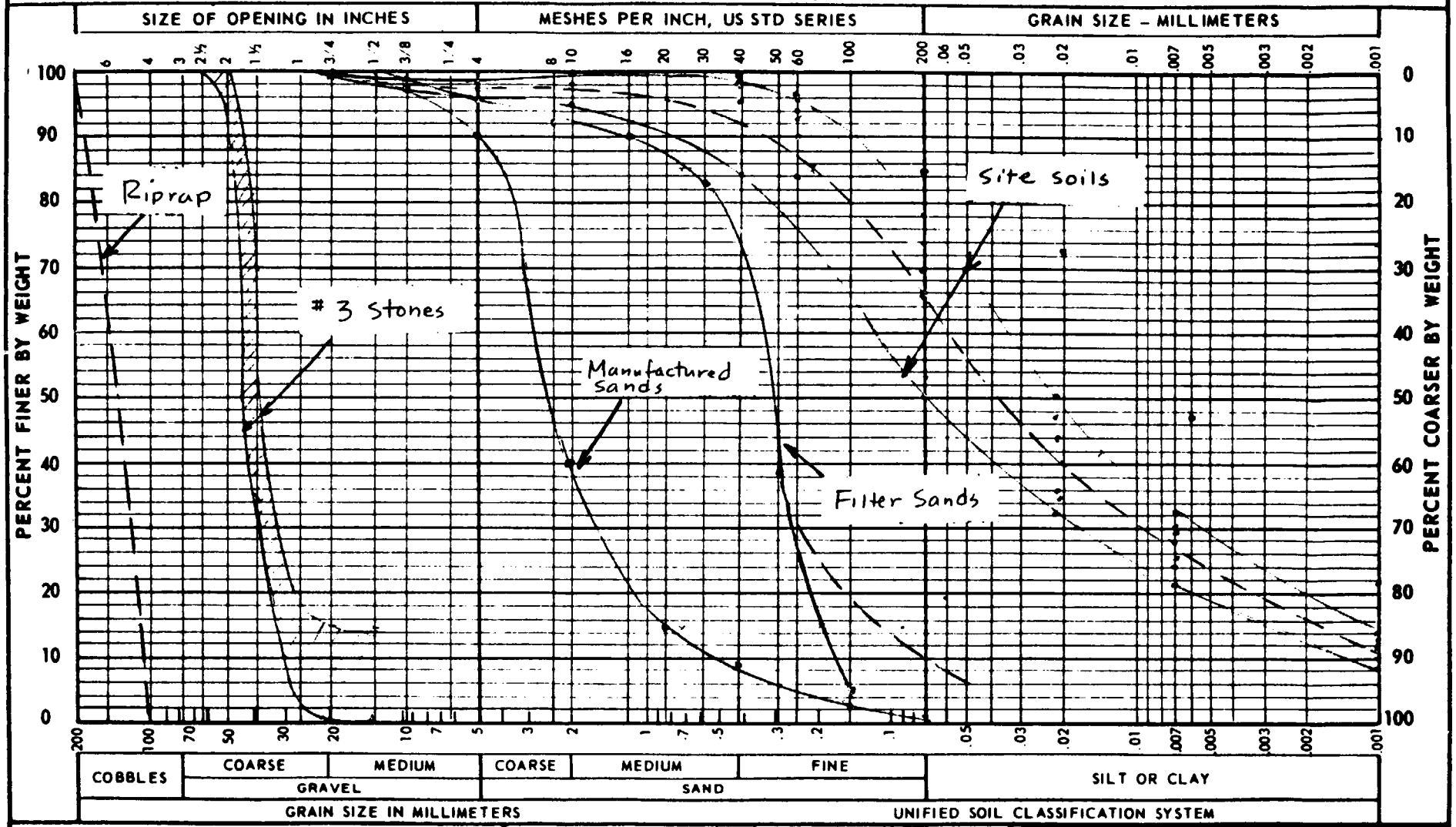
1) Design of Slope Protection materials is based on passing the grain size criteria of one material with respect to the overlying material as outlined in the references 1 to 4 calculation No. 1.

2) The grain sizes of various materials were determined based on laboratory grain size analyses performed on each type of material. Grain sizes of all materials are presented graphically on page 3.

1314-15/8-72

# MECHANICAL ANALYSIS GRAPH OF GRANULAR MATERIALS

*(In Accordance With ASTM D422, Section 16)*




| | |
|---|---|
| TEST NO. | |
| SAMPLE NO. | P-01, 02, 03, 04, 05, 06, 07 & 08 |
| SAMPLE LOCATION | Central Tract |
| SAMPLE ELEVATION | Depth 0 to 6" from surface |

**SAMPLE DESCRIPTION**

Lees Lane Landfill Site

——— Site Soils

——— Filter Sands

EBASCO SERVICES INCORPORATED

LEES LANE LANDFILL

PROJECT

| DRAWN BY | CHECKED BY | DATE |
|---|---|---|
| PKH LIU | R.A. KOSLER | 6/16/87 |

——— Manufactured Sands

——— # 3 Stones

— — — Riprap

EBASCO SERVICES INCORPORATED

CALCULATION COVER SHEET

CLIENT: EPA

PROJECT: LEE'S LANE LANDFILL, JEFFERSON COUNTY, KENTUCKY

SUBJECT: GRAIN SIZE DISTRIBUTION CURVES FOR ROCK CONSIDERED FOR DRAINAGE LAYERS

OFS. NO. 9236.172 DEPT. 503

CALCULATION NO. 3 NUMBER OF SHEETS 4 (including this sheet) 6 | RI WHITAKER C 10-5-87

SUPERSEDES CALC. NO. N/A

| REV. NO. | REVISION DESCRIPTION | CALC BY Name /Date | CHECKED BY Name /Date |
|---|---|---|---|
| 0 | NOT APPLICABLE | SOURCE: ENVIRONMENTAL SCIENCE & ENGINEERING, INC. | |
| 1 | ADDED: TABLE OF CONTENTS (SH1); BASIS OF DESIGN DATA DEVELOPMENT (SH2); PAGE TITLES (SH 3,4&5); SIGNATURES FOR REV 0. | M. Dumani 10/12/87 | K Kistler 10/13/87 |
| | | | |
| | | | |

* FULL SIGNATURE (FIRST NAME, INITIAL AND LAST NAME)

EBASCO SERVICES INCORPORATED

BY CAW DATE 10-5-87 SHEET 1 OF 5

CHKD. BY MD DATE 10-12-87 OFS NO. 4226.721 DEPT. NO. [illegible]

CLIENT EPA

PROJECT LEE'S LANE LANDFILL, JEFFERSON COUNTY, KENTUCKY

SUBJECT GRAIN SIZE DIST. CURVES FOR ROCK CONSIDERED FOR DRAINAGE LAYERS

# TABLE OF CONTENTS



THE DESIGN CRITERIA DOCUMENT FOR THIS PROJECT IS PROVIDED UNDER SEPARATE COVER.

EBASCO SERVICES INCORPORATED

BY M. Durrani DATE 10/12/87 SHEET 2 OF 5

CHKD. BY K Kuba DATE 10/13/87 OFS NO. _____ DEPT. NO. 503

CLIENT E.P.A.

PROJECT LEE'S LAND LANDFILL

SUBJECT Grain Size Curves for Drainage Layer Rock

## BASIS OF DESIGN DATA:

The grain size diameter used in calculations are determined based on a laboratory grain size analyses performed on the representative samples by the Environmental Science and Engineering. See Pages 3, 4 and 5 for details

EBASCO SERVICES INCORPORATED

SH 3 OF 5

EPA LEE'S LANE LANDFILL

RI

GRAIN SIZE DIST. CURVES FOR ROCK CONSIDERED FOR DRAINAGE LAYERS

WHITAKER C
10-587

ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.

RECEIVED

JUN 06 1987

K. A. Kessler

MEMORANDUM

DATE: 6/2/87

TIME:

TO: Mike Szomjassy, Ebasco

FROM: Wayne Ingram

PROJECT: A L Taylor

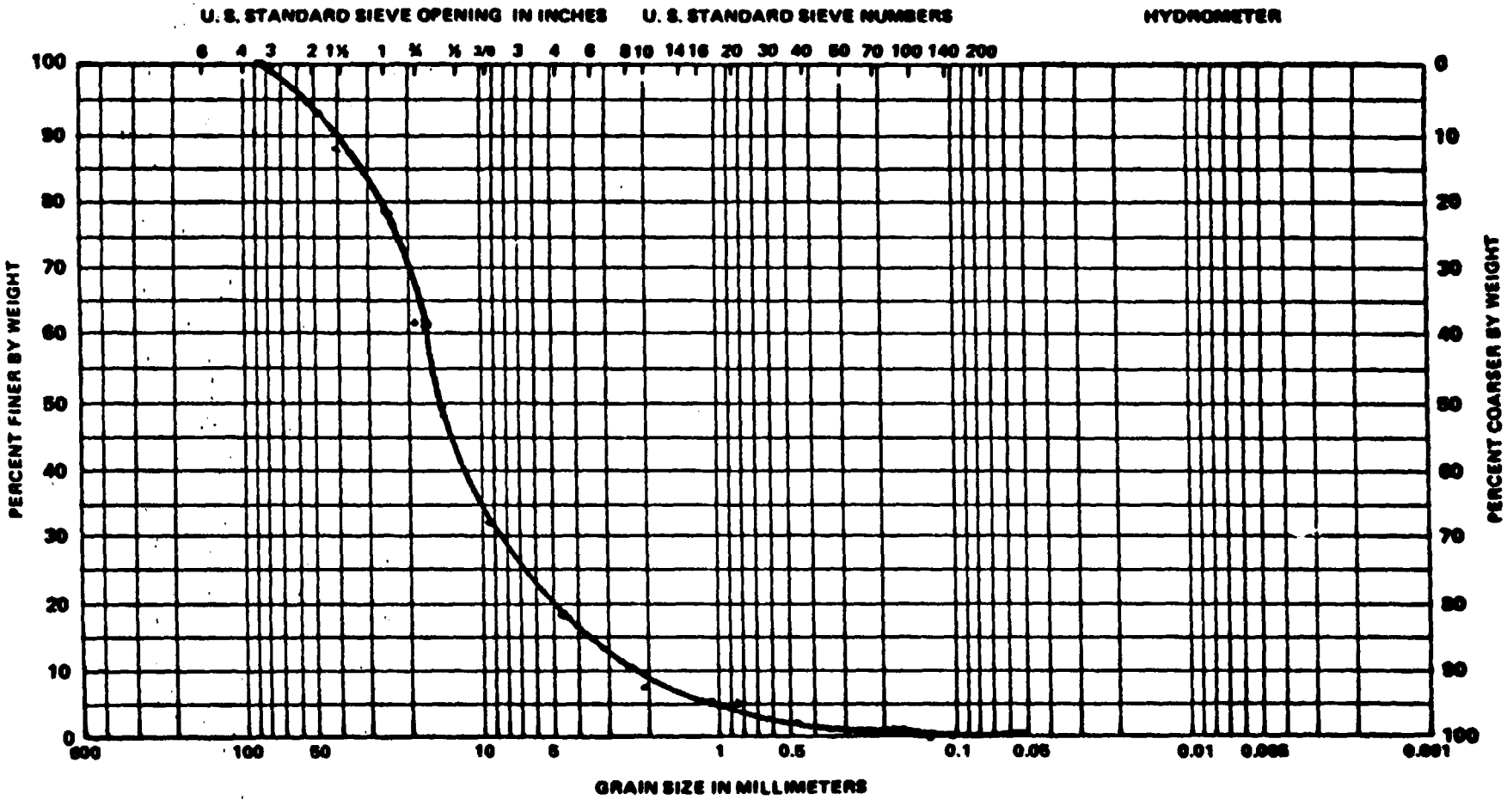
RE: Particle-size distribution curves for drainage layer material

Enclosed are curves for the rock considered for the drainage layer at A L Taylor site. Call if you need additional information.

RECEIVED
REM III REGION IV
JUN 3 '87

| | ACT. | INFO. |
|---|---|---|
| TW | | |
| A. BEAR | | |
| K. KESSLER | | |
| DJK | | |
| SCF | | |
| LE ALT | | |

For Lees Lane info




SOURCE: ENVIRONMENTAL SCIENCE AND ENGINEERING, INC., 1988

GRAIN SIZE DISTRIBUTION CURVE "Dirty Rock"

WELL GRADED GRAVEL (GW)

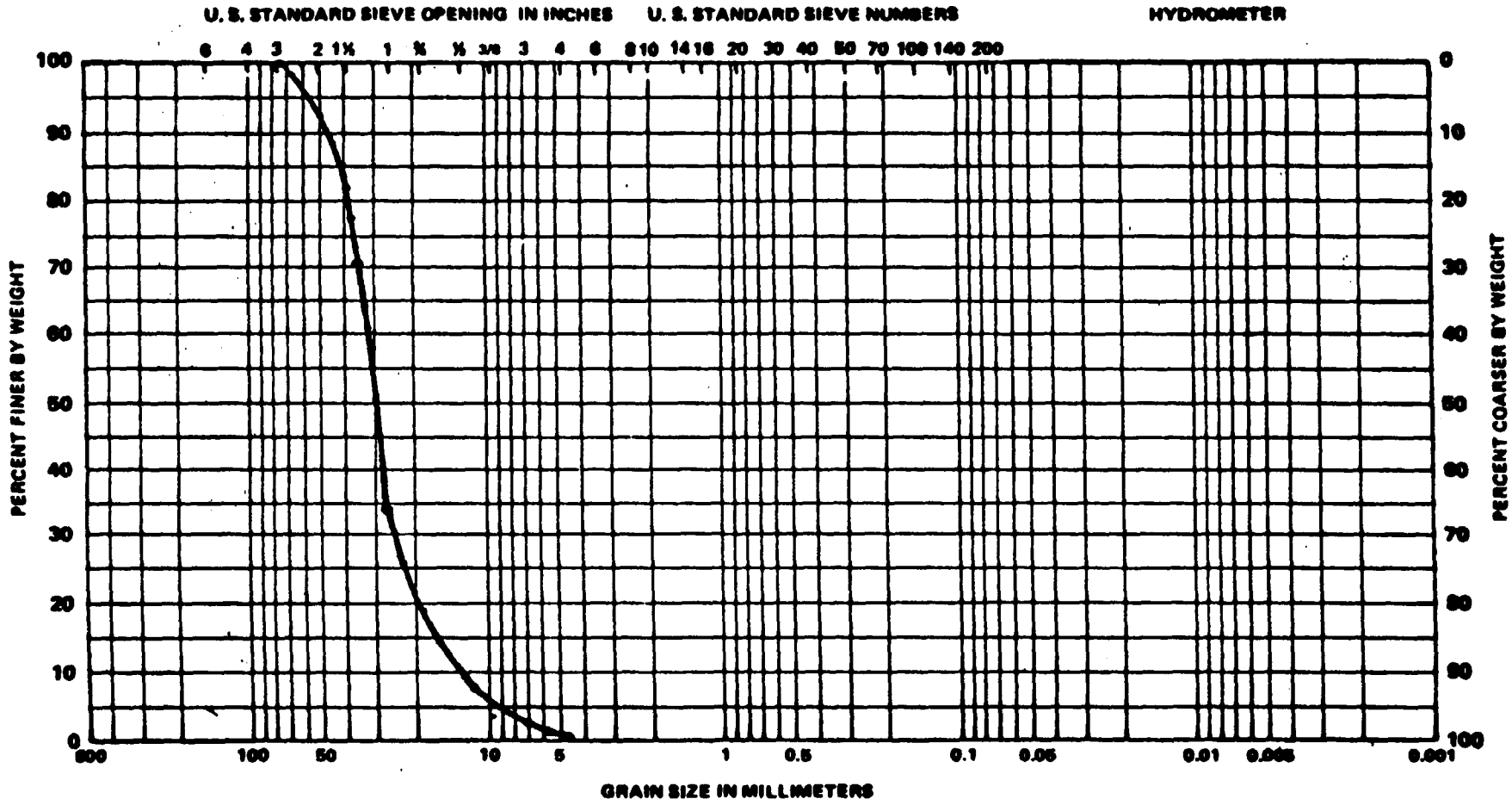
A.L. TAYLOR SITE

EBASCO SERVICES INCORPORATED

EPA LEE'S LANE LANDFILL SH 4 OF 5

RI

WHITAKER C 10-5-87




SOURCE: ENVIRONMENTAL SCIENCE AND ENGINEERING, INC., 1988

GRAIN SIZE DISTRIBUTION CURVE

POORLY GRADED GRAVEL (GP)

A.L. TAYLOR SITE

"Clean Rock"

EBASCO SERVICES INCORPORATED

EPA LEE'S LANE LANDFILL SH 5 OF 5 | RI WHITAKER C 10-5-87

EBASCO SERVICES INCORPORATED

CALCULATION COVER SHEET

CLIENT: EPA

PROJECT: LEE'S LANE LANDFILL, JEFFERSON COUNTY, KENTUCKY

SUBJECT: SLOPE STABILITY ANALYSIS + COMPUTER OUTPUT SHTS. #1 THRU #8 (ATTACHMENTS)

OFS. NO. 4236.721 DEPT.

CALCULATION NO. 4 NUMBER OF SHEETS ~~24~~ 33 (including this sheet) | RI WHITAKER C 10-6-87

SUPERSEDES CALC. NO. N/A

| REV. NO. | REVISION DESCRIPTION | CALC BY Name /Date | CHECKED BY Name /Date |
|---|---|---|---|
| 0 | NOT APPLICABLE | W. S. C. 7/17/87 | P. KH. Lee 7/17/87 |
| 1 | ADDED: TABLE OF CONTENTS; SIGNATURES FOR REV 0. | M Durrani 10/12/87 | K. Kesler 10/13/87 |
| | | | |
| | | | |

* FULL SIGNATURE (FIRST NAME, INITIAL AND LAST NAME)

# TABLE OF CONTENTS



## ATTACHMENTS

ALL ATTACHMENTS ARE STABR COMPUTER PROGRAM RUNS



THE DESIGN CRITERIA DOCUMENT FOR THIS PROJECT IS PROVIDED UNDER SEPARATE COVER.

RI WHITAKER C 10-6-87

**EBASCO SERVICES INCORPORATED**

BY PKHLIU DATE 6/22/87 SHEET 1 OF 6

CHKD. BY KHK DATE 7/30/87 OFS NO. DEPT. NO.

CLIENT EPA

PROJECT LEES LANE LANDFILL

SUBJECT SLOPE STABILITY ANALYSIS

REFERENCES:


(1) "Final Remedial Investigation and Feasibility Study of Alternatives" Lees Lane Landfill Site, Jefferson County, Kentucky. Vol I: Remedial Investigation, April 1986 Revision 2. & Vol III. Appendices. April 1986.

(2) "STABR = A Computer program for Slope Stability Analysis with Circular Slip Surfaces", Microcomputer Version by J M Duncan and Kai Sin Wong Report No. UCB/GT/84-09. Dept. of Civil Engineering UC Berkeley, California, April, 1984.

(3) "Foundation Analysis and Design", 3rd Edition by J E Bowles. McGraw-Hill Book Co, 1982

**EBASCO SERVICES INCORPORATED**

BY PKHLIU DATE 6/24/87 SHEET 2 OF 6

CHKD. BY KAK DATE 7/31/87 OFS NO. DEPT. NO.

CLIENT EPA

PROJECT LEES LANE LANDFILL

SUBJECT SLOPE STABILITY ANALYSIS

Sources of Information used to established the model and the Parameters for slope stability analysis

Reference (1) of P.1

| | |
|---|---|
| - Figure 3-7 | Landfill Boundary |
| - Figure 3-9 | Areas Used to Calculate fill Volume |
| - Table 3-2 | Areas & Depth Values Used to Calculate Waste Volume |
| - Table 4-3 | Groundwater Elevations |
| - Figure 4-1 | Boring Location |
| - Figure 4-3 | Cross Section 1-4 & 1-3 |
| - Figure 4-4 | Cross Section MW-02 & MW-05 |
| - Figure 4-5 | Fence Diagram |
| - Appendix D. | Boring Log MW-04 & MW-05 |

- "Topography Survey Map." by Horne Engineering Inc of Nicholasville, Kentucky. July 1987

- Soil strength properties selected for analysis was based on Boring MW-04 & MW-05 & Ref. 3

**EBASCO SERVICES INCORPORATED**

BY WSL DATE 7-17-87 SHEET 3 OF 6

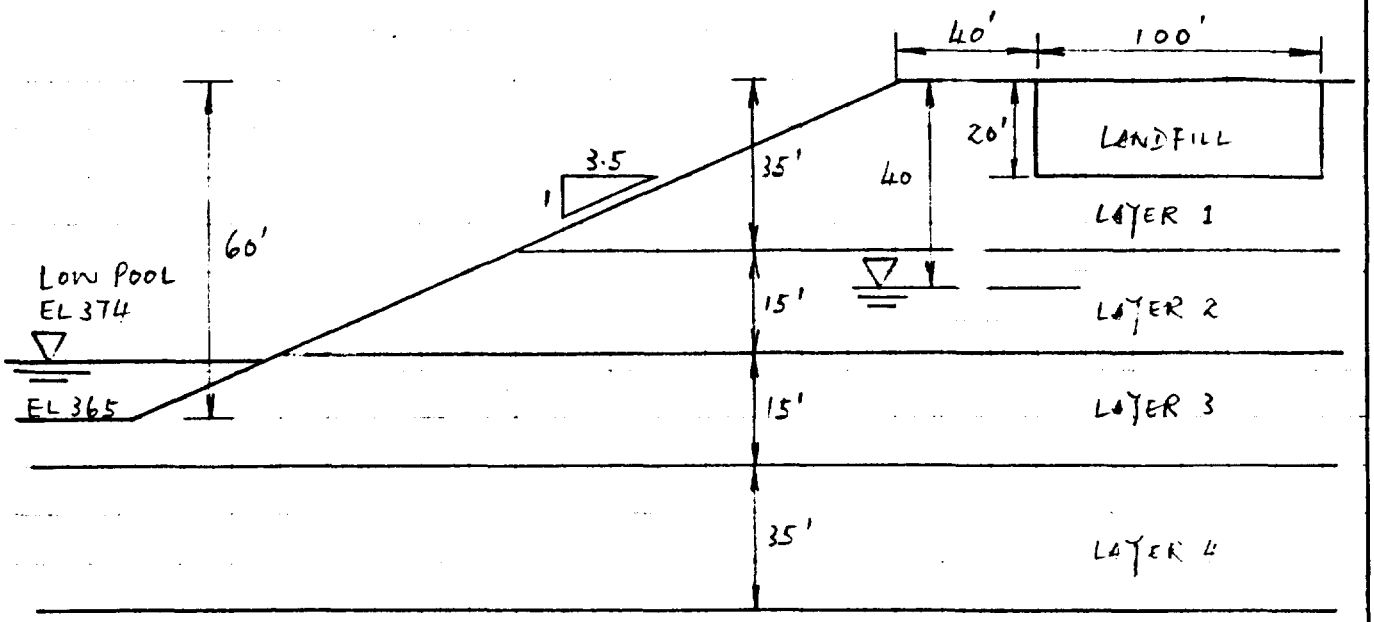
CHKD. BY PKHLIN DATE 7/17/87 OFS NO. DEPT. NO.

CLIENT EPA

PROJECT LEES LANE LANDFILL

SUBJECT SLOPE STABILITY ANALYSIS

THE SLOPE ADJACENT TO THE LANDFILL WAS ANALYSED WITH THE FOLLOWING CONFIGURATION:




AND SOIL PROPERTIES:

| | UNDRAINED PROPERTIES HIGH CASE | UNDRAINED PROPERTIES LOW CASE | DRAINED PROPERTIES: HIGH CASE | DRAINED PROPERTIES: LOW CASE |
|---|---|---|---|---|
| LAYER 1: SANDY SILTY CLAY | $S_u$ = 500psf, $\phi$ = 0° | 400, 0° | C = 100psf, $\phi'$ = 18° | 50, 18° |
| LAYER 2: " | $S_u$ = 900psf, $\phi$ = 0° | 700, 0° | C = 100psf, $\phi'$ = 25° | 50, 25° |
| LAYER 3: SAND & GRAVEL | $S_u$ = 0, $\phi$ = 33° | 0, 30° | C = 0, $\phi'$ = 33° | 0, 30° |
| LAYER 4: " | $S_u$ = 0, $\phi$ = 36° | 0, 36° | C = 0, $\phi'$ = 36° | 0, 36° |
| LANDFILL | $S_u$ = 0, $\phi$ = 6° | 0, 6° | C = 0, $\phi$ = 6° | 0, 6° |

**EBASCO SERVICES INCORPORATED**

BY WSL DATE 7-17-87 SHEET 4 OF 6
CHKD. BY PEHLIN DATE 7/17/87 OFS NO. DEPT. NO.
CLIENT EPA
PROJECT LEES LANE LANDFILL
SUBJECT SLOPE STABILITY ANALYSIS

THE PROPERTIES USED IN THIS ANALYSIS ARE ESTIMATED FROM THE STANDARD PENETRATION TESTS. NO LABORATORY TESTS WERE PERFORMED.

IN THE DRAINED CASE, THE SLIP CIRCLES THAT ARE TANGENT TO THE TOP OF LAYERS 2 AND 4 (THE MOST LIKELY PLACE WHERE IF FAILURE IS GOING TO OCCUR) HAVE F.S. GREATER THAN 1.5 WITH HIGHER SOIL PROPERTIES AND F.S. SLIGHTLY LESS THAN 1.5 WITH LOWER SOIL PROPERTIES. (SEE PAGE 5)

IN THE UNDRAINED CASE, THE SLIP CIRCLES THAT ARE TANGENT TO THE TOP OF LAYER 2 AND 4 HAVE F.S. LESS THEN 1.5 WITH BOTH HIGHER AND LOWER SOIL PROPERTIES. HOWEVER, WITH THE HIGHER SOIL PROPERTIES, THE F.S. OBTAINED ARE ONLY SLIGHTLY LESS THEN 1.5 (1.456 FOR SLIP CIRCLE TANGENT TO LAYER 4 AND 1.431 FOR SLIP CIRCLE TANGENT TO LAYER 2, SEE PAGE 6)

THE FACT THAT THE EXISTING SLOPE HAS BEEN STABLE FOR THE PAST, THE SOIL PROPERTIES ESTIMATED FROM THE STANDARD PENETRATION TESTS (SPT) MAY BE TOO LOW (ESPECIALLY FOR THE UNDRAINED PROPERTIES WHICH IS EXPECTED SINCE SPT RESULTS ARE GENERALLY NOT AS GOOD AN UNDRAINED STRENGTH INDICATOR AS DRAINED STRENGTH). LAB. TESTING MAY COME UP WITH A BETTER ESTIMATE OF THE SOIL STRENGTHS AND THUS INCREASES THE F.S.

TO CONCLUDE, SINCE THE EXISTING STABLE AND SLIGHTLY STEEPER SLOPE WILL BE FLATTENED TO A 1 TO 3.5 SLOPE, THE NEW FLATTENED SLOPE IS EXPECTED TO CONTINUE TO BE STABLE IN SPITE OF THE SLIGHTLY LOWER CALCULATED F.S. BASED ON THE CONSERVATIVE ESTIMATES OF THE SOIL STRENGTHS FROM THE SPT's.

CLIENT EPA

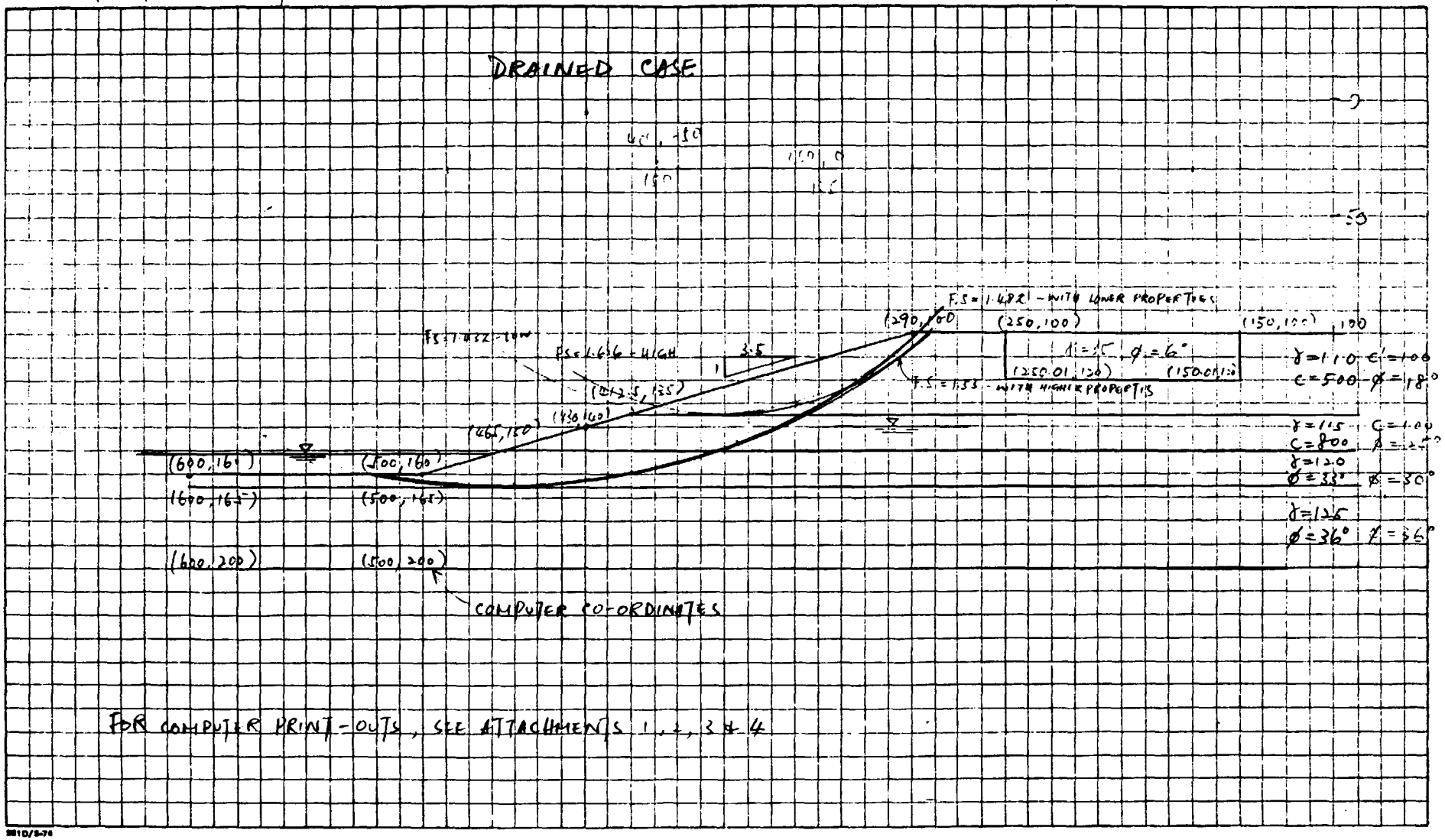
PROJECT LEES LANE LANDFILL

SUBJECT SLOPE STABILITY ANALYSIS

OFS NO. _____ DEPT. NO. _____

BY _____ DATE _____

CHECKED BY _____ DATE _____




FOR COMPUTER PRINT-OUTS, SEE ATTACHMENTS 1, 2, 3 & 4

CLIENT EPA

PROJECT LEES LANE LANDFILL

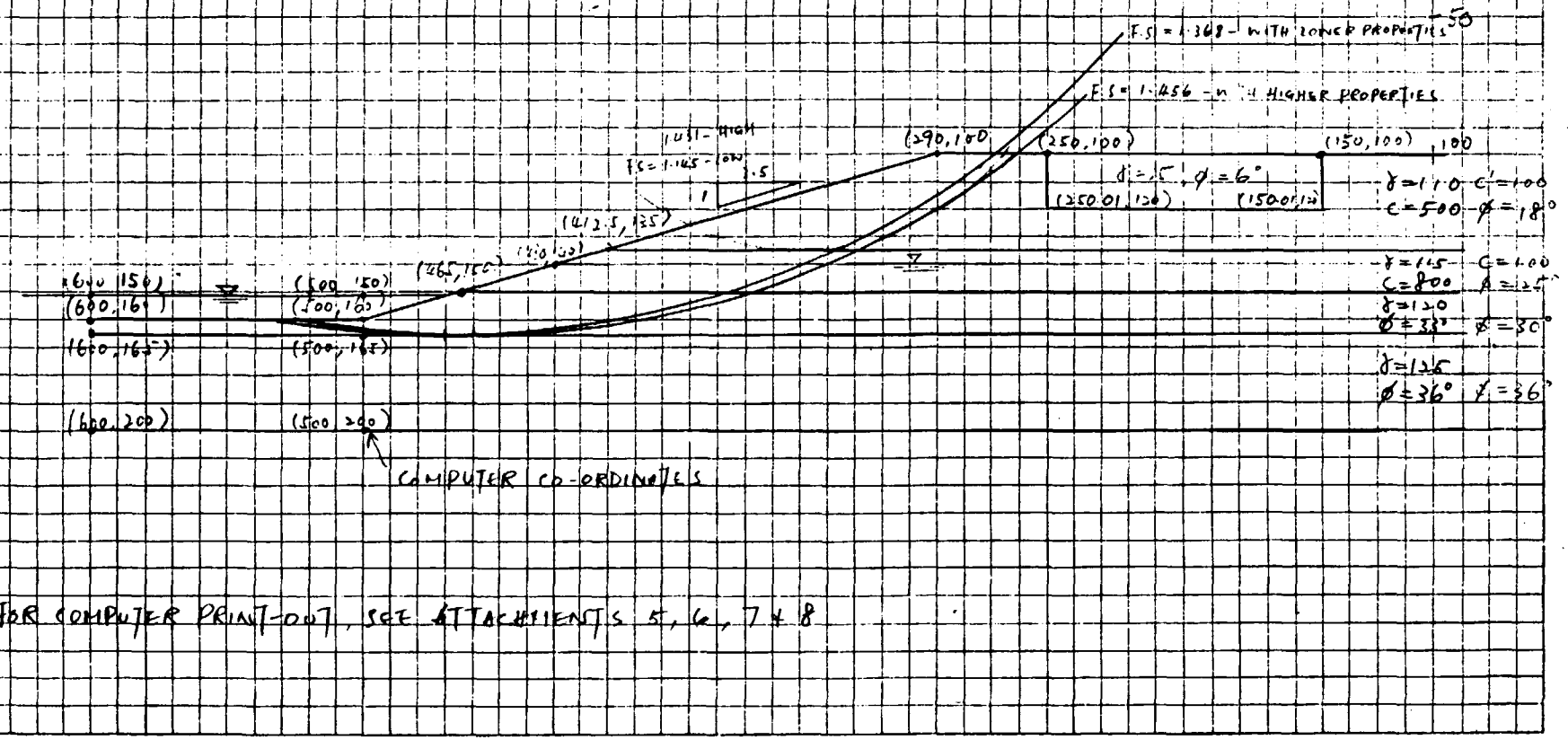
SUBJECT SLOPE STABILITY ANALYSIS

OFS NO. _____ DEPT. NO. _____

BY _____ DATE _____

CHECKED BY _____ DATE _____

## UNDRAINED CASE




FOR COMPUTER PRINT-OUT, SEE ATTACHMENTS 5, 6, 7 & 8

ATTACHMENT #1

Program STABR -- Version 3.84 (MS-DOS)

0 BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

LEES LANE LANDFILL (DRAINED CASE - HIGHER PROPERTIES)
0CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 1 |
| NUMBER OF VERTICAL SECTIONS | 10 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | 1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

0SEISMIC COEFFICIENT S1,S2 = .00, .00
0UNIT WEIGHT OF WATER = 62.40
0SEARCH IS BASED ON BISHOP MODIFIED METHOD

SEARCH STARTS AT CENTER ( 430.0, -50.0) WITH FINAL GRID OF 10.0
0ALL CIRCLES TANGENT TO DEPTH, 165.0,
0GEOMETRY

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 SECTIONS | 100.0 | 150.0 | 150.0 | 250.0 | 250.0 | 290.0 | 412.5 | 465.0 | 500.0 | 600.0 |
| T. CRACKS | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 150.0 | 150.0 | 150.0 |
| W IN CRACK | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 150.0 | 150.0 | 150.0 |
| BOUNDARY 1 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 150.0 | 150.0 | 150.0 |
| BOUNDARY 2 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 150.0 | 160.0 | 160.0 |
| BOUNDARY 3 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 150.0 | 160.0 | 160.0 |
| BOUNDARY 4 | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 | 150.0 | 160.0 | 160.0 |
| BOUNDARY 5 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 160.0 | 160.0 |
| BOUNDARY 6 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 |
| BOUNDARY 7 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 |

0SOIL PROPERTIES

| 0 LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | .0 | .0 | 62.4 |
| 2 | .0 | 6.0 | 35.0 |
| 3 | 100.0 | 18.0 | 110.0 |
| 4 | 100.0 | 25.0 | 115.0 |
| 5 | .0 | 30.0 | 120.0 |
| 6 | .0 | 36.0 | 125.0 |

0PORE PRESSURE DATA
COORDINATES OF EQUI-PRESSURE LINES

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 SECTIONS | 100.0 | 150.0 | 150.0 | 250.0 | 250.0 | 290.0 | 412.5 | 465.0 | 500.0 | 600.0 |
| LINE 1 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 150.0 | 150.0 | 150.0 |

0 BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

LEES LANE LANDFILL (DRAINED CASE - HIGHER PROPERTIES)

| 0NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 165.0 | 215.0 | 430.0 | -50.0 | 1.612 | 1.521 |
| 2 | 165.0 | 215.0 | 410.0 | -50.0 | 1.772 | 1.664 |
| 3 | 165.0 | 235.0 | 430.0 | -70.0 | 1.635 | 1.553 |
| 4 | 165.0 | 215.0 | 450.0 | -50.0 | 1.546 | 1.469 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6 | 165.0 | 215.0 | 440.0 | -50.0 | 1.56[illegible] | 1.484 |
| 7 | 165.0 | 225.0 | 450.0 | -60.0 | 1.545 | 1.472 |
| 8 | 165.0 | 215.0 | 460.0 | -50.0 | 1.532 | 1.460 |
| 9 | 165.0 | 205.0 | 450.0 | -40.0 | 1.547 | 1.466 |
| 10 | 165.0 | 225.0 | 460.0 | -60.0 | 1.531 | 1.463 |
| 11 | 165.0 | 215.0 | 470.0 | -50.0 | 1.533 | 1.463 |
| 12 | 165.0 | 205.0 | 460.0 | -40.0 | 1.532 | 1.456 |
| 13 | 165.0 | 225.0 | 450.0 | -60.0 | 1.545 | 1.472 |
| 14 | 165.0 | 235.0 | 460.0 | -70.0 | 1.531 | 1.466 |
| 15 | 165.0 | 225.0 | 470.0 | -60.0 | 1.533 | 1.467 |
| 16 | 165.0 | 235.0 | 450.0 | -70.0 | 1.543 | 1.474 |
| 17 | 165.0 | 245.0 | 460.0 | -80.0 | 1.531 | 1.469 |
| 18 | 165.0 | 235.0 | 470.0 | -70.0 | 1.533 | 1.470 |
| 19 | 165.0 | 245.0 | 450.0 | -80.0 | 1.545 | 1.478 |
| 20 | 165.0 | 255.0 | 460.0 | -90.0 | 1.530 | 1.471 |
| 21 | 165.0 | 245.0 | 470.0 | -80.0 | 1.532 | 1.472 |
| 22 | 165.0 | 255.0 | 450.0 | -90.0 | 1.550 | 1.486 |
| 23 | 165.0 | 265.0 | 460.0 | -100.0 | 1.530 | 1.473 |
| 24 | 165.0 | 255.0 | 470.0 | -90.0 | 1.532 | 1.475 |
| 25 | 165.0 | 265.0 | 450.0 | -100.0 | 1.558 | 1.497 |
| 26 | 165.0 | 275.0 | 460.0 | -110.0 | 1.534 | 1.479 |
| 27 | 165.0 | 265.0 | 470.0 | -100.0 | 1.532 | 1.477 |
| 28 | 165.0 | 275.0 | 450.0 | -110.0 | 1.568 | 1.510 |
| 29 | 165.0 | 275.0 | 470.0 | -110.0 | 1.531 | 1.479 |
| 30 | 165.0 | 255.0 | 470.0 | -90.0 | 1.532 | 1.475 |
| 31 | 165.0 | 255.0 | 450.0 | -90.0 | 1.550 | 1.486 |

OF.S. MINIMUM= 1.530 FOR THE CIRCLE OF CENTER ( 460.0,-100.0)

ATTACHMENT 2

Program STABR -- Version 3.84 (MS-DOS)

0 BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

LEES LANE LANDFILL (DRAINED CASE - HIGHER PROPERTIES)
0CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 1 |
| NUMBER OF VERTICAL SECTIONS | 10 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | 1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

0SEISMIC COEFFICIENT S1,S2 = .00, .00
0UNIT WEIGHT OF WATER = 62.40
0SEARCH IS BASED ON BISHOP MODIFIED METHOD

SEARCH STARTS AT CENTER ( 350.0, .0) WITH FINAL GRID OF 10.0
0ALL CIRCLES TANGENT TO DEPTH, 135.0,
0GEOMETRY

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 SECTIONS | 100.0 | 150.0 | 150.0 | 250.0 | 250.0 | 290.0 | 412.5 | 465.0 | 500.0 | 600.0 |
| T. CRACKS | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 150.0 | 150.0 | 150.0 |
| W IN CRACK | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 150.0 | 150.0 | 150.0 |
| BOUNDARY 1 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 150.0 | 150.0 | 150.0 |
| BOUNDARY 2 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 150.0 | 160.0 | 160.0 |
| BOUNDARY 3 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 150.0 | 160.0 | 160.0 |
| BOUNDARY 4 | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 | 150.0 | 160.0 | 160.0 |
| BOUNDARY 5 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 160.0 | 160.0 |
| BOUNDARY 6 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 |
| BOUNDARY 7 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 |

0SOIL PROPERTIES

| 0 LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | .0 | .0 | 62.4 |
| 2 | .0 | 6.0 | 35.0 |
| 3 | 100.0 | 18.0 | 110.0 |
| 4 | 100.0 | 25.0 | 115.0 |
| 5 | .0 | 30.0 | 120.0 |
| 6 | .0 | 36.0 | 125.0 |

0PORE PRESSURE DATA
COORDINATES OF EQUI-PRESSURE LINES

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| SECTIONS | 100.0 | 150.0 | 150.0 | 250.0 | 250.0 | 290.0 | 412.5 | 465.0 | 500.0 | 600.0 |
| LINE 1 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 150.0 | 150.0 | 150.0 |

0 BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

LEES LANE LANDFILL (DRAINED CASE - HIGHER PROPERTIES)

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 135.0 | 135.0 | 350.0 | .0 | 1.825 | 1.741 |
| 2 | 135.0 | 135.0 | 330.0 | .0 | 2.216 | 2.104 |
| 3 | 135.0 | 155.0 | 350.0 | -20.0 | 1.885 | 1.812 |
| 4 | 135.0 | 135.0 | 370.0 | .0 | 1.629 | 1.565 |
| 5 | 135.0 | 115.0 | 350.0 | 20.0 | 1.772 | 1.674 |
| 6 | 135.0 | 135.0 | 360.0 | .0 | 1.702 | 1.628 |
| 7 | 135.0 | 145.0 | 370.0 | -10.0 | 1.640 | 1.580 |
| 8 | 135.0 | 135.0 | 380.0 | .0 | 1.629 | 1.575 |
| 9 | 135.0 | 125.0 | 370.0 | 10.0 | 1.626 | 1.557 |
| 10 | 135.0 | 125.0 | 360.0 | 10.0 | 1.682 | 1.603 |
| 11 | 135.0 | 125.0 | 380.0 | 10.0 | 1.648 | 1.592 |
| 12 | 135.0 | 115.0 | 370.0 | 20.0 | 1.634 | 1.560 |
| 13 | 135.0 | 135.0 | 360.0 | .0 | 1.702 | 1.628 |
| 14 | 135.0 | 135.0 | 380.0 | .0 | 1.629 | 1.575 |
| 15 | 135.0 | 115.0 | 380.0 | 20.0 | 1.669 | 1.609 |
| 16 | 135.0 | 115.0 | 360.0 | 20.0 | 1.669 | 1.583 |

OF.S. MINIMUM= 1.626 FOR THE CIRCLE OF CENTER ( 370.0, 10.0)

ATTACHMENT 3

Program STABR -- Version 3.84 (MS-DOS)

0 BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

LEES LANE LANDFILL (DRAINED CASE) - LOWER SOIL PROPERTIES
0CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 1 |
| NUMBER OF VERTICAL SECTIONS | 10 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | 1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

0SEISMIC COEFFICIENT S1,S2 = .00, .00
0UNIT WEIGHT OF WATER = 62.40
0SEARCH IS BASED ON BISHOP MODIFIED METHOD

SEARCH STARTS AT CENTER ( 430.0, -50.0) WITH FINAL GRID OF 10.0
0ALL CIRCLES TANGENT TO DEPTH, 165.0,
0GEOMETRY

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| SECTIONS | 100.0 | 150.0 | 150.0 | 250.0 | 250.0 | 290.0 | 412.5 | 465.0 | 500.0 | 600.0 |
| T. CRACKS | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 150.0 | 150.0 | 150.0 |
| W IN CRACK | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 150.0 | 150.0 | 150.0 |
| BOUNDARY 1 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 150.0 | 150.0 | 150.0 |
| BOUNDARY 2 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 150.0 | 160.0 | 160.0 |
| BOUNDARY 3 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 150.0 | 160.0 | 160.0 |
| BOUNDARY 4 | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 | 150.0 | 160.0 | 160.0 |
| BOUNDARY 5 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 160.0 | 160.0 |
| BOUNDARY 6 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 |
| BOUNDARY 7 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 |

0SOIL PROPERTIES

| 0 LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | .0 | .0 | 62.4 |
| 2 | .0 | 6.0 | 35.0 |
| 3 | 50.0 | 18.0 | 110.0 |
| 4 | 50.0 | 25.0 | 115.0 |
| 5 | .0 | 30.0 | 120.0 |
| 6 | .0 | 36.0 | 125.0 |

0PORE PRESSURE DATA
COORDINATES OF EQUI-PRESSURE LINES

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 SECTIONS | 100.0 | 150.0 | 150.0 | 250.0 | 250.0 | 290.0 | 412.5 | 465.0 | 500.0 | 600.0 |
| LINE 1 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 150.0 | 150.0 | 150.0 |

0 BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

LEES LANE LANDFILL (DRAINED CASE)

| 0NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 165.0 | 215.0 | 430.0 | -50.0 | 1.580 | 1.487 |
| 2 | 165.0 | 215.0 | 410.0 | -50.0 | 1.744 | 1.635 |
| 3 | 165.0 | 235.0 | 430.0 | -70.0 | 1.604 | 1.520 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | 165.0 | 215.0 | 430.0 | -30.0 | 1.569 | 1.465 |
| 5 | 165.0 | 195.0 | 440.0 | -50.0 | 1.532 | 1.445 |
| 6 | 165.0 | 215.0 | 450.0 | -60.0 | 1.505 | 1.429 |
| 7 | 165.0 | 225.0 | 460.0 | -50.0 | 1.488 | 1.413 |
| 8 | 165.0 | 215.0 | 450.0 | -40.0 | 1.508 | 1.424 |
| 9 | 165.0 | 205.0 | 460.0 | -60.0 | 1.487 | 1.416 |
| 10 | 165.0 | 225.0 | 470.0 | -50.0 | 1.484 | 1.411 |
| 11 | 165.0 | 215.0 | 460.0 | -40.0 | 1.488 | 1.410 |
| 12 | 165.0 | 205.0 | 470.0 | -60.0 | 1.484 | 1.415 |
| 13 | 165.0 | 225.0 | 480.0 | -50.0 | 1.501 | 1.426 |
| 14 | 165.0 | 215.0 | 470.0 | -40.0 | 1.484 | 1.407 |
| 15 | 165.0 | 205.0 | 460.0 | -60.0 | 1.487 | 1.416 |
| 16 | 165.0 | 225.0 | 470.0 | -70.0 | 1.483 | 1.418 |
| 17 | 165.0 | 235.0 | 480.0 | -60.0 | 1.499 | 1.429 |
| 18 | 165.0 | 225.0 | 460.0 | -70.0 | 1.487 | 1.420 |
| 19 | 165.0 | 235.0 | 470.0 | -80.0 | 1.483 | 1.421 |
| 20 | 165.0 | 245.0 | 480.0 | -70.0 | 1.497 | 1.431 |
| 21 | 165.0 | 235.0 | 460.0 | -80.0 | 1.487 | 1.422 |
| 22 | 165.0 | 245.0 | 470.0 | -90.0 | 1.483 | 1.423 |
| 23 | 165.0 | 255.0 | 480.0 | -80.0 | 1.496 | 1.433 |
| 24 | 165.0 | 245.0 | 460.0 | -90.0 | 1.486 | 1.425 |
| 25 | 165.0 | 255.0 | 470.0 | -100.0 | 1.483 | 1.426 |
| 26 | 165.0 | 265.0 | 480.0 | -90.0 | 1.495 | 1.435 |
| 27 | 165.0 | 255.0 | 460.0 | -100.0 | 1.487 | 1.428 |
| 28 | 165.0 | 265.0 | 470.0 | -110.0 | 1.482 | 1.428 |
| 29 | 165.0 | 275.0 | 480.0 | -100.0 | 1.494 | 1.436 |
| 30 | 165.0 | 265.0 | 460.0 | -110.0 | 1.491 | 1.435 |
| 31 | 165.0 | 275.0 | 470.0 | -120.0 | 1.482 | 1.429 |
| 32 | 165.0 | 285.0 | 480.0 | -110.0 | 1.492 | 1.438 |
| 33 | 165.0 | 275.0 | 460.0 | -120.0 | 1.498 | 1.444 |
| 34 | 165.0 | 285.0 | 470.0 | -130.0 | 1.484 | 1.433 |
| 35 | 165.0 | 295.0 | 480.0 | -120.0 | 1.491 | 1.439 |
| 36 | 165.0 | 285.0 | 460.0 | -130.0 | 1.507 | 1.455 |
| 37 | 165.0 | 295.0 | 480.0 | -130.0 | 1.490 | 1.440 |
| 38 | 165.0 | 295.0 | 480.0 | -110.0 | 1.492 | 1.438 |
| 39 | 165.0 | 275.0 | 460.0 | -110.0 | 1.491 | 1.435 |
| 40 | 165.0 | 275.0 | | | | |

OF.S. MINIMUM= 1.482 FOR THE CIRCLE OF CENTER ( 470.0,-120.0)

ATTACHMENT 4

Program STABR -- Version 3.84 (MS-DOS)

0 BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

LEES LANE LANDFILL (DRAINED CASE)- LOWER SOIL PROPERTIES
0CONTROL DATA
NUMBER OF SPECIFIED CENTERS 0
NUMBER OF DEPTH LIMITING TANGENTS 1
NUMBER OF VERTICAL SECTIONS 10
NUMBER OF SOIL LAYER BOUNDARIES 7
NUMBER OF PORE PRESSURE LINES 1
NUMBER OF POINTS DEFINING COHESION PROFILE 0
0SEISMIC COEFFICIENT S1,S2 = .00, .00
0UNIT WEIGHT OF WATER = 62.40
0SEARCH IS BASED ON BISHOP MODIFIED METHOD

EARCH STARTS AT CENTER ( 350.0, .0) WITH FINAL GRID OF 10.0
.LL CIRCLES TANGENT TO DEPTH, 135.0,
0GEOMETRY

| 0 SECTIONS | 100.0 | 150.0 | 150.0 | 250.0 | 250.0 | 290.0 | 412.5 | 465.0 | 500.0 | 600.0 |
|---|---|---|---|---|---|---|---|---|---|---|
| T. CRACKS | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 150.0 | 150.0 | 150.0 |
| W IN CRACK | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 150.0 | 150.0 | 150.0 |
| BOUNDARY 1 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 150.0 | 150.0 | 150.0 |
| BOUNDARY 2 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 150.0 | 160.0 | 160.0 |
| BOUNDARY 3 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 150.0 | 160.0 | 160.0 |
| BOUNDARY 4 | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 | 150.0 | 160.0 | 160.0 |
| BOUNDARY 5 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 160.0 | 160.0 |
| BOUNDARY 6 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 |
| BOUNDARY 7 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 |

0SOIL PROPERTIES

| 0 LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | .0 | .0 | 62.4 |
| 2 | .0 | 6.0 | 35.0 |
| 3 | 50.0 | 18.0 | 110.0 |
| 4 | 50.0 | 25.0 | 115.0 |
| 5 | .0 | 30.0 | 120.0 |
| 6 | .0 | 36.0 | 125.0 |

0PORE PRESSURE DATA
COORDINATES OF EQUI-PRESSURE LINES

| 0 SECTIONS | 100.0 | 150.0 | 150.0 | 250.0 | 250.0 | 290.0 | 412.5 | 465.0 | 500.0 | 600.0 |
|---|---|---|---|---|---|---|---|---|---|---|
| LINE 1 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 150.0 | 150.0 | 150.0 |

0 BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

LEES LANE LANDFILL (DRAINED CASE)

| 0NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| 2 | 135.0 | 135.0 | 330.0 | .0 | 2.064 | 1.953 |
| 3 | 135.0 | 155.0 | 350.0 | -20.0 | 1.738 | 1.666 |
| 4 | 135.0 | 135.0 | 370.0 | .0 | 1.466 | 1.402 |
| 5 | 135.0 | 115.0 | 350.0 | 20.0 | 1.628 | 1.530 |
| 6 | 135.0 | 135.0 | 360.0 | .0 | 1.552 | 1.478 |
| 7 | 135.0 | 145.0 | 370.0 | -10.0 | 1.480 | 1.420 |
| 8 | 135.0 | 135.0 | 380.0 | .0 | 1.438 | 1.384 |
| 9 | 135.0 | 125.0 | 370.0 | 10.0 | 1.459 | 1.390 |
| 10 | 135.0 | 145.0 | 380.0 | -10.0 | 1.432 | 1.380 |
| 11 | 135.0 | 135.0 | 390.0 | .0 | 1.458 | 1.415 |
| 12 | 135.0 | 125.0 | 380.0 | 10.0 | 1.451 | 1.394 |
| 13 | 135.0 | 145.0 | 370.0 | -10.0 | 1.480 | 1.420 |
| 14 | 135.0 | 155.0 | 380.0 | -20.0 | 1.435 | 1.387 |
| 15 | 135.0 | 145.0 | 390.0 | -10.0 | 1.446 | 1.405 |
| 16 | 135.0 | 155.0 | 370.0 | -20.0 | 1.497 | 1.441 |
| 17 | 135.0 | 155.0 | 390.0 | -20.0 | 1.436 | 1.396 |
| 18 | 135.0 | 135.0 | 390.0 | .0 | 1.458 | 1.415 |
| 19 | 135.0 | 135.0 | 370.0 | .0 | 1.466 | 1.402 |

OF.S. MINIMUM= 1.432 FOR THE CIRCLE OF CENTER ( 380.0, -10.0)

ATTACHMENT 5

Program STABR -- Version 3.84 (MS-DOS)

0 BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

LEES LANE LANDFILL (UNDRAINED CASE) – ~~LOWER~~ HIGHER SOIL PROPERTIES

0CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 1 |
| NUMBER OF VERTICAL SECTIONS | 11 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | 1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 4 |

0SEISMIC COEFFICIENT S1,S2 = .00, .00
NIT WEIGHT OF WATER = 62.40
..EARCH IS BASED ON BISHOP MODIFIED METHOD

SEARCH STARTS AT CENTER ( 430.0, -50.0) WITH FINAL GRID OF 10.0
0ALL CIRCLES TANGENT TO DEPTH, 165.0,
0GEOMETRY

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 SECTIONS | 100.0 | 150.0 | 150.0 | 250.0 | 250.0 | 290.0 | 412.5 | 430.0 | 465.0 | 500.0 | 600. |
| T. CRACKS | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 140.0 | 150.0 | 150.0 | 150. |
| W IN CRACK | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 140.0 | 150.0 | 150.0 | 150. |
| BOUNDARY 1 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 140.0 | 150.0 | 150.0 | 150. |
| BOUNDARY 2 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 140.0 | 150.0 | 160.0 | 160. |
| BOUNDARY 3 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 140.0 | 150.0 | 160.0 | 160. |
| BOUNDARY 4 | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 | 140.0 | 150.0 | 160.0 | 160. |
| BOUNDARY 5 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 160.0 | 160. |
| BOUNDARY 6 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165. |
| BOUNDARY 7 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200. |

0SOIL PROPERTIES

| 0 LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | .0 | .0 | 62.4 |
| 2 | .0 | 6.0 | 35.0 |
| 3 | -1.0 | .0 | 110.0 |
| 4 | -1.0 | .0 | 115.0 |
| 5 | .0 | 33.0 | 120.0 |
| 6 | .0 | 36.0 | 125.0 |

0PORE PRESSURE DATA
. COORDINATES OF EQUI-PRESSURE LINES

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 SECTIONS | 100.0 | 150.0 | 150.0 | 250.0 | 250.0 | 290.0 | 412.5 | 430.0 | 465.0 | 500.0 | 600. |
| LINE 1 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 150.0 | 150.0 | 150. |

0SPECIFIED COHESION VS DEPTH

| 0 DEPTH | COHESION |
|---|---|
| 100.0 | 500.0 |
| 135.0 | 500.0 |
| 135.0 | 800.0 |

0 BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

EES LANE LANDFILL (UNDRAINED CASE)

| ONUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 165.0 | 215.0 | 430.0 | -50.0 | 1.534 | 1.524 |
| 2 | 165.0 | 215.0 | 410.0 | -50.0 | 1.642 | 1.624 |
| 3 | 165.0 | 235.0 | 430.0 | -70.0 | 1.527 | 1.523 |
| 4 | 165.0 | 215.0 | 450.0 | -50.0 | 1.568 | 1.557 |
| 5 | 165.0 | 195.0 | 430.0 | -30.0 | 1.561 | 1.543 |
| 6 | 165.0 | 235.0 | 420.0 | -70.0 | 1.580 | 1.573 |
| 7 | 165.0 | 245.0 | 430.0 | -80.0 | 1.528 | 1.526 |
| 8 | 165.0 | 235.0 | 440.0 | -70.0 | 1.505 | 1.503 |
| 9 | 165.0 | 225.0 | 430.0 | -60.0 | 1.528 | 1.522 |
| 10 | 165.0 | 245.0 | 440.0 | -80.0 | 1.498 | 1.498 |
| 11 | 165.0 | 235.0 | 450.0 | -70.0 | 1.526 | 1.523 |
| 12 | 165.0 | 225.0 | 440.0 | -60.0 | 1.517 | 1.512 |
| 13 | 165.0 | 245.0 | 430.0 | -80.0 | 1.528 | 1.526 |
| 14 | 165.0 | 255.0 | 440.0 | -90.0 | 1.494 | 1.496 |
| 15 | 165.0 | 245.0 | 450.0 | -80.0 | 1.505 | 1.505 |
| 16 | 165.0 | 255.0 | 430.0 | -90.0 | 1.532 | 1.532 |
| 17 | 165.0 | 265.0 | 440.0 | -100.0 | 1.493 | 1.497 |
| 18 | 165.0 | 255.0 | 450.0 | -90.0 | 1.490 | 1.492 |
| 19 | 165.0 | 265.0 | 450.0 | -100.0 | 1.480 | 1.484 |
| 20 | 165.0 | 255.0 | 460.0 | -90.0 | 1.537 | 1.536 |
| 21 | 165.0 | 245.0 | 450.0 | -80.0 | 1.505 | 1.505 |
| 22 | 165.0 | 265.0 | 440.0 | -100.0 | 1.493 | 1.497 |
| 23 | 165.0 | 275.0 | 450.0 | -110.0 | 1.473 | 1.479 |
| 24 | 165.0 | 265.0 | 460.0 | -100.0 | 1.512 | 1.513 |
| 25 | 165.0 | 275.0 | 440.0 | -110.0 | 1.495 | 1.500 |
| 26 | 165.0 | 285.0 | 450.0 | -120.0 | 1.469 | 1.477 |
| 27 | 165.0 | 275.0 | 460.0 | -110.0 | 1.492 | 1.496 |
| 28 | 165.0 | 285.0 | 440.0 | -120.0 | 1.499 | 1.505 |
| 29 | 165.0 | 295.0 | 450.0 | -130.0 | 1.469 | 1.477 |
| 30 | 165.0 | 285.0 | 460.0 | -120.0 | 1.478 | 1.484 |
| 31 | 165.0 | 295.0 | 440.0 | -130.0 | 1.504 | 1.512 |
| 32 | 165.0 | 305.0 | 450.0 | -140.0 | 1.470 | 1.480 |
| 33 | 165.0 | 295.0 | 460.0 | -130.0 | 1.468 | 1.475 |
| 34 | 165.0 | 305.0 | 460.0 | -140.0 | 1.462 | 1.470 |
| 35 | 165.0 | 295.0 | 470.0 | -130.0 | 1.518 | 1.521 |
| 36 | 165.0 | 285.0 | 460.0 | -120.0 | 1.478 | 1.484 |
| 37 | 165.0 | 305.0 | 450.0 | -140.0 | 1.470 | 1.480 |
| 38 | 165.0 | 315.0 | 460.0 | -150.0 | 1.458 | 1.468 |
| 39 | 165.0 | 305.0 | 470.0 | -140.0 | 1.498 | 1.503 |
| 40 | 165.0 | 315.0 | 450.0 | -150.0 | 1.473 | 1.484 |
| 41 | 165.0 | 325.0 | 460.0 | -160.0 | 1.456 | 1.467 |
| 42 | 165.0 | 315.0 | 470.0 | -150.0 | 1.483 | 1.490 |
| 43 | 165.0 | 325.0 | 450.0 | -160.0 | 1.477 | 1.489 |
| 44 | 165.0 | 335.0 | 460.0 | -170.0 | 1.456 | 1.468 |
| 45 | 165.0 | 325.0 | 470.0 | -160.0 | 1.472 | 1.480 |
| 46 | 165.0 | 335.0 | 450.0 | -170.0 | 1.483 | 1.496 |
| 47 | 165.0 | 335.0 | 470.0 | -170.0 | 1.464 | 1.473 |
| 48 | 165.0 | 315.0 | 470.0 | -150.0 | 1.483 | 1.490 |
| 49 | 165.0 | 315.0 | 450.0 | -150.0 | 1.473 | 1.484 |

OF.S. MINIMUM= 1.456 FOR THE CIRCLE OF CENTER ( 460.0,-160.0)

ATTACHMENT 6

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 Program STABR -- Version 3.84 (MS-DOS)


0         BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES


 LEES LANE LANDFILL (UNDRAINED CASE) - HIGHER SOIL PROPERTIES
0CONTROL DATA
       NUMBER OF SPECIFIED CENTERS                    0
       NUMBER OF DEPTH LIMITING TANGENTS              1
       NUMBER OF VERTICAL SECTIONS                   11
       NUMBER OF SOIL LAYER BOUNDARIES                7
       NUMBER OF PORE PRESSURE LINES                  1
       NUMBER OF POINTS DEFINING COHESION PROFILE     4
0SEISMIC COEFFICIENT S1,S2    =    .00,   .00
  NIT WEIGHT OF WATER         =       62.40
0SEARCH IS BASED ON BISHOP MODIFIED METHOD

 SEARCH STARTS AT CENTER ( 350.0,     .0) WITH FINAL GRID OF 10.0
0ALL CIRCLES TANGENT TO DEPTH, 135.0,
0GEOMETRY
0     SECTIONS   100.0 150.0 150.0 250.0 250.0 290.0 412.5 430.0 465.0 500.0 600

      T. CRACKS  100.0 100.0 100.0 100.0 100.0 100.0 135.0 140.0 150.0 150.0 150
      W IN CRACK 100.0 100.0 100.0 100.0 100.0 100.0 135.0 140.0 150.0 150.0 150
      BOUNDARY 1 100.0 100.0 100.0 100.0 100.0 100.0 135.0 140.0 150.0 150.0 150
      BOUNDARY 2 100.0 100.0 100.0 100.0 100.0 100.0 135.0 140.0 150.0 160.0 160
      BOUNDARY 3 100.0 100.0 100.0 100.0 100.0 100.0 135.0 140.0 150.0 160.0 160
      BOUNDARY 4 135.0 135.0 135.0 135.0 135.0 135.0 135.0 140.0 150.0 160.0 160
      BOUNDARY 5 150.0 150.0 150.0 150.0 150.0 150.0 150.0 150.0 150.0 160.0 160
      BOUNDARY 6 165.0 165.0 165.0 165.0 165.0 165.0 165.0 165.0 165.0 165.0 165
      BOUNDARY 7 200.0 200.0 200.0 200.0 200.0 200.0 200.0 200.0 200.0 200.0 200
0SOIL PROPERTIES
0       LAYER          COHESION    FRICTION ANGLE      DENSITY
          1               .0             .0             62.4
          2               .0            6.0             35.0
          3             -1.0             .0            110.0
          4             -1.0             .0            115.0
          5               .0           33.0            120.0
          6               .0           36.0            125.0
 PORE PRESSURE DATA
       COORDINATES OF EQUI-PRESSURE LINES
0      SECTIONS  100.0 150.0 150.0 250.0 250.0 290.0 412.5 430.0 465.0 500.0 600
       LINE  1   140.0 140.0 140.0 140.0 140.0 140.0 140.0 140.0 150.0 150.0 150
0SPECIFIED COHESION VS DEPTH
0      DEPTH    COHESION
      100.0      500.0
      135.0      500.0
```

FC

0 BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

EES LANE LANDFILL (UNDRAINED CASE)

| ONUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 135.0 | 135.0 | 350.0 | .0 | 1.451 | 1.451 |
| 2 | 135.0 | 135.0 | 330.0 | .0 | 1.514 | 1.514 |
| 3 | 135.0 | 155.0 | 350.0 | -20.0 | 1.469 | 1.469 |
| 4 | 135.0 | 135.0 | 370.0 | .0 | 1.628 | 1.628 |
| 5 | 135.0 | 115.0 | 350.0 | 20.0 | 1.446 | 1.446 |
| 6 | 135.0 | 115.0 | 340.0 | 20.0 | 1.438 | 1.438 |
| 7 | 135.0 | 125.0 | 350.0 | 10.0 | 1.446 | 1.446 |
| 8 | 135.0 | 115.0 | 360.0 | 20.0 | 1.525 | 1.525 |
| 9 | 135.0 | 105.0 | 350.0 | 30.0 | 1.451 | 1.451 |
| 10 | 135.0 | 115.0 | 330.0 | 20.0 | 1.484 | 1.484 |
| 11 | 135.0 | 125.0 | 340.0 | 10.0 | 1.448 | 1.448 |
| 12 | 135.0 | 105.0 | 340.0 | 30.0 | 1.432 | 1.432 |
| 13 | 135.0 | 105.0 | 330.0 | 30.0 | 1.472 | 1.472 |
| 14 | 135.0 | 105.0 | 350.0 | 30.0 | 1.451 | 1.451 |
| 15 | 135.0 | 95.0 | 340.0 | 40.0 | 1.431 | 1.431 |
| 16 | 135.0 | 95.0 | 330.0 | 40.0 | 1.464 | 1.464 |
| 17 | 135.0 | 95.0 | 350.0 | 40.0 | 1.467 | 1.467 |
| 18 | 135.0 | 85.0 | 340.0 | 50.0 | 1.439 | 1.439 |
| 19 | 135.0 | 105.0 | 330.0 | 30.0 | 1.472 | 1.472 |
| 20 | 135.0 | 105.0 | 350.0 | 30.0 | 1.451 | 1.451 |
| 21 | 135.0 | 85.0 | 350.0 | 50.0 | 1.499 | 1.499 |
| 22 | 135.0 | 85.0 | 330.0 | 50.0 | 1.463 | 1.463 |

.S. MINIMUM= 1.431 FOR THE CIRCLE OF CENTER ( 340.0, 40.0)

ATTACHMENT 7

Program STABR -- Version 3.84 (MS-DOS)

0 BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

LEES LANE LANDFILL (UNDRAINED CASE - LOWER PROPERTIES)
0CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 1 |
| NUMBER OF VERTICAL SECTIONS | 11 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | 1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 4 |

0SEISMIC COEFFICIENT S1,S2 = .00, .00
0UNIT WEIGHT OF WATER = 62.40
0SEARCH IS BASED ON BISHOP MODIFIED METHOD

SEARCH STARTS AT CENTER ( 430.0, -50.0) WITH FINAL GRID OF 10.0
0ALL CIRCLES TANGENT TO DEPTH, 165.0,
0GEOMETRY

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 SECTIONS | 100.0 | 150.0 | 150.0 | 250.0 | 250.0 | 290.0 | 412.5 | 430.0 | 465.0 | 500.0 | 600. |
| T. CRACKS | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 140.0 | 150.0 | 150.0 | 150. |
| W IN CRACK | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 140.0 | 150.0 | 150.0 | 150 |
| BOUNDARY 1 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 140.0 | 150.0 | 150.0 | 150. |
| BOUNDARY 2 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 140.0 | 150.0 | 160.0 | 160 |
| BOUNDARY 3 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 140.0 | 150.0 | 160.0 | 160 |
| BOUNDARY 4 | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 | 140.0 | 150.0 | 160.0 | 160 |
| BOUNDARY 5 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 160.0 | 160 |
| BOUNDARY 6 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165 |
| BOUNDARY 7 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200 |

0SOIL PROPERTIES

| 0 LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | .0 | .0 | 62.4 |
| 2 | .0 | 6.0 | 35.0 |
| 3 | -1.0 | .0 | 110.0 |
| 4 | -1.0 | .0 | 115.0 |
| 5 | .0 | 33.0 | 120.0 |
| 6 | .0 | 36.0 | 125.0 |

0PORE PRESSURE DATA
COORDINATES OF EQUI-PRESSURE LINES

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 SECTIONS | 100.0 | 150.0 | 150.0 | 250.0 | 250.0 | 290.0 | 412.5 | 430.0 | 465.0 | 500.0 | 600 |
| LINE 1 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 150.0 | 150.0 | 150 |

0SPECIFIED COHESION VS DEPTH

| 0 DEPTH | COHESION |
|---|---|
| 100.0 | 400.0 |
| 135.0 | 400.0 |
| 135.0 | 700.0 |
| 150.0 | 700.0 |

0 BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

#7

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | | |
|---|---|---|---|---|---|---|
| 1 | 165.0 | 215.0 | 430.0 | -50.0 | 1.463 | 1.456 |
| 2 | 165.0 | 215.0 | 410.0 | -50.0 | 1.580 | 1.565 |
| 3 | 165.0 | 235.0 | 430.0 | -70.0 | 1.457 | 1.456 |
| 4 | 165.0 | 215.0 | 450.0 | -50.0 | 1.479 | 1.472 |
| 5 | 165.0 | 195.0 | 430.0 | -30.0 | 1.487 | 1.472 |
| 6 | 165.0 | 235.0 | 420.0 | -70.0 | 1.515 | 1.510 |
| 7 | 165.0 | 245.0 | 430.0 | -80.0 | 1.459 | 1.459 |
| 8 | 165.0 | 235.0 | 440.0 | -70.0 | 1.428 | 1.429 |
| 9 | 165.0 | 225.0 | 430.0 | -60.0 | 1.458 | 1.454 |
| 10 | 165.0 | 245.0 | 440.0 | -80.0 | 1.422 | 1.425 |
| 11 | 165.0 | 235.0 | 450.0 | -70.0 | 1.439 | 1.439 |
| 12 | 165.0 | 225.0 | 440.0 | -60.0 | 1.439 | 1.437 |
| 13 | 165.0 | 245.0 | 430.0 | -80.0 | 1.459 | 1.459 |
| 14 | 165.0 | 255.0 | 440.0 | -90.0 | 1.419 | 1.424 |
| 15 | 165.0 | 245.0 | 450.0 | -80.0 | 1.420 | 1.423 |
| 16 | 165.0 | 255.0 | 430.0 | -90.0 | 1.463 | 1.466 |
| 17 | 165.0 | 265.0 | 440.0 | -100.0 | 1.419 | 1.425 |
| 18 | 165.0 | 255.0 | 450.0 | -90.0 | 1.406 | 1.412 |
| 19 | 165.0 | 265.0 | 450.0 | -100.0 | 1.397 | 1.404 |
| 20 | 165.0 | 255.0 | 460.0 | -90.0 | 1.441 | 1.443 |
| 21 | 165.0 | 245.0 | 450.0 | -80.0 | 1.420 | 1.423 |
| 22 | 165.0 | 265.0 | 440.0 | -100.0 | 1.419 | 1.425 |
| 23 | 165.0 | 275.0 | 450.0 | -110.0 | 1.391 | 1.401 |
| 24 | 165.0 | 265.0 | 460.0 | -100.0 | 1.418 | 1.423 |
| 25 | 165.0 | 275.0 | 440.0 | -110.0 | 1.421 | 1.429 |
| 26 | 165.0 | 285.0 | 450.0 | -120.0 | 1.389 | 1.399 |
| 27 | 165.0 | 275.0 | 460.0 | -110.0 | 1.400 | 1.407 |
| 28 | 165.0 | 285.0 | 440.0 | -120.0 | 1.425 | 1.434 |
| 29 | 165.0 | 295.0 | 450.0 | -130.0 | 1.388 | 1.400 |
| 30 | 165.0 | 285.0 | 460.0 | -120.0 | 1.388 | 1.397 |
| 31 | 165.0 | 295.0 | 460.0 | -130.0 | 1.379 | 1.390 |
| 32 | 165.0 | 285.0 | 470.0 | -120.0 | 1.438 | 1.442 |
| 33 | 165.0 | 275.0 | 460.0 | -110.0 | 1.400 | 1.407 |
| 34 | 165.0 | 295.0 | 450.0 | -130.0 | 1.388 | 1.400 |
| 35 | 165.0 | 305.0 | 460.0 | -140.0 | 1.373 | 1.386 |
| 36 | 165.0 | 295.0 | 470.0 | -130.0 | 1.415 | 1.422 |
| 37 | 165.0 | 305.0 | 450.0 | -140.0 | 1.390 | 1.403 |
| 38 | 165.0 | 315.0 | 460.0 | -150.0 | 1.370 | 1.384 |
| 39 | 165.0 | 305.0 | 470.0 | -140.0 | 1.398 | 1.406 |
| 40 | 165.0 | 315.0 | 450.0 | -150.0 | 1.394 | 1.408 |
| 41 | 165.0 | 325.0 | 460.0 | -160.0 | 1.369 | 1.384 |
| 42 | 165.0 | 315.0 | 470.0 | -150.0 | 1.385 | 1.395 |
| 43 | 165.0 | 325.0 | 450.0 | -160.0 | 1.398 | 1.414 |
| 44 | 165.0 | 335.0 | 460.0 | -170.0 | 1.370 | 1.386 |
| 45 | 165.0 | 325.0 | 470.0 | -160.0 | 1.375 | 1.387 |
| 46 | 165.0 | 335.0 | 450.0 | -170.0 | 1.405 | 1.421 |
| 47 | 165.0 | 335.0 | 470.0 | -170.0 | 1.368 | 1.381 |
| 48 | 165.0 | 315.0 | 470.0 | -150.0 | 1.385 | 1.395 |
| 49 | 165.0 | 315.0 | 450.0 | -150.0 | 1.394 | 1.408 |
| 50 | 165.0 | 345.0 | 470.0 | -180.0 | 1.364 | 1.378 |
| 51 | 165.0 | 335.0 | 480.0 | -170.0 | 1.410 | 1.418 |

SEARCH IS ABANDONED AFTER 51CIRCLES

ATTACHMENT 8

Program STABR -- Version 3.84 (MS-DOS)

0 BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

LEES LANE LANDFILL (UNDRAINED CASE - LOWER PROPERTIES)
0CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 1 |
| NUMBER OF VERTICAL SECTIONS | 11 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | 1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 4 |

0SEISMIC COEFFICIENT S1,S2 = .00, .00
0UNIT WEIGHT OF WATER = 62.40
0SEARCH IS BASED ON BISHOP MODIFIED METHOD

SEARCH STARTS AT CENTER ( 350.0, .0) WITH FINAL GRID OF 10.0
LL CIRCLES TANGENT TO DEPTH, 135.0,
0GEOMETRY

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 SECTIONS | 100.0 | 150.0 | 150.0 | 250.0 | 250.0 | 290.0 | 412.5 | 430.0 | 465.0 | 500.0 | 600 |
| T. CRACKS | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 140.0 | 150.0 | 150.0 | 150 |
| W IN CRACK | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 140.0 | 150.0 | 150.0 | 150 |
| BOUNDARY 1 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 140.0 | 150.0 | 150.0 | 150 |
| BOUNDARY 2 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 140.0 | 150.0 | 160.0 | 160 |
| BOUNDARY 3 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 135.0 | 140.0 | 150.0 | 160.0 | 160 |
| BOUNDARY 4 | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 | 140.0 | 150.0 | 160.0 | 160 |
| BOUNDARY 5 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 160.0 | 160 |
| BOUNDARY 6 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165 |
| BOUNDARY 7 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 | 200 |

0SOIL PROPERTIES

| 0 LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | .0 | .0 | 62.4 |
| 2 | .0 | 6.0 | 35.0 |
| 3 | -1.0 | .0 | 110.0 |
| 4 | -1.0 | .0 | 115.0 |
| 5 | .0 | 33.0 | 120.0 |
| 6 | .0 | 36.0 | 125.0 |

0PORE PRESSURE DATA
COORDINATES OF EQUI-PRESSURE LINES

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 SECTIONS | 100.0 | 150.0 | 150.0 | 250.0 | 250.0 | 290.0 | 412.5 | 430.0 | 465.0 | 500.0 | 600 |
| LINE 1 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 | 150.0 | 150.0 | 150 |

SPECIFIED COHESION VS DEPTH

| DEPTH | COHESION |
|---|---|
| 100.0 | 400.0 |
| 135.0 | 400.0 |
| 135.0 | 700.0 |
| 150.0 | 700.0 |

LEES LANE LANDFILL (UNDRAINED CASE - LOWER PROPERTIES)

| ONUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 135.0 | 135.0 | 350.0 | .0 | 1.161 | 1.161 |
| 2 | 135.0 | 135.0 | 330.0 | .0 | 1.211 | 1.211 |
| 3 | 135.0 | 155.0 | 350.0 | -20.0 | 1.176 | 1.176 |
| 4 | 135.0 | 135.0 | 370.0 | .0 | 1.302 | 1.302 |
| 5 | 135.0 | 115.0 | 350.0 | 20.0 | 1.157 | 1.157 |
| 6 | 135.0 | 115.0 | 340.0 | 20.0 | 1.150 | 1.150 |
| 7 | 135.0 | 125.0 | 350.0 | 10.0 | 1.157 | 1.157 |
| 8 | 135.0 | 115.0 | 360.0 | 20.0 | 1.220 | 1.220 |
| 9 | 135.0 | 105.0 | 350.0 | 30.0 | 1.161 | 1.161 |
| 10 | 135.0 | 115.0 | 330.0 | 20.0 | 1.187 | 1.187 |
| 11 | 135.0 | 125.0 | 340.0 | 10.0 | 1.158 | 1.158 |
| 12 | 135.0 | 105.0 | 340.0 | 30.0 | 1.145 | 1.145 |
| 13 | 135.0 | 105.0 | 330.0 | 30.0 | 1.178 | 1.178 |
| 14 | 135.0 | 105.0 | 350.0 | 30.0 | 1.161 | 1.161 |
| 15 | 135.0 | 95.0 | 340.0 | 40.0 | 1.145 | 1.145 |
| 16 | 135.0 | 95.0 | 330.0 | 40.0 | 1.171 | 1.171 |
| 17 | 135.0 | 95.0 | 350.0 | 40.0 | 1.174 | 1.174 |
| 18 | 135.0 | 85.0 | 340.0 | 50.0 | 1.152 | 1.152 |
| 19 | 135.0 | 105.0 | 330.0 | 30.0 | 1.178 | 1.178 |
| 20 | 135.0 | 105.0 | 350.0 | 30.0 | 1.161 | 1.161 |
| 21 | 135.0 | 85.0 | 350.0 | 50.0 | 1.199 | 1.199 |
| 22 | 135.0 | 85.0 | 330.0 | 50.0 | 1.170 | 1.170 |

OF.S. MINIMUM= 1.145 FOR THE CIRCLE OF CENTER ( 340.0, 40.0)

EBASCO SERVICES INCORPORATED

CALCULATION COVER SHEET

CLIENT: ENVIRONMENTAL PROTECTION AGENCY

PROJECT: LEE'S LANE LANDFILL, JEFFERSON COUNTY, KENTUCKY

SUBJECT: SOIL SAMPLE DATA, SIEVE ANALYSIS

OFS. NO. 4236.721 DEPT. 503

CALCULATION NO. 5 NUMBER OF SHEETS 9
(including this sheet)

SUPERSEDES CALC. NO. N/A

| REV. NO. | REVISION DESCRIPTION | CALC BY Name*/Date | CHECKED BY Name*/Date |
|---|---|---|---|
| 0 | NOT APPLICABLE | LAW ENGINEERING | |
| | | | |
| | | | |
| | | | |

* FULL SIGNATURE (FIRST NAME, INITIAL AND LAST NAME)

LAW ENGINEERING TESTING COMPANY
SOIL SAMPLE DATA

PROJECT NAME & NO. ARE EBASC SERVICES,INC. 705.502
BORING NUMBER IS BS-1
SAMPLE IDENTIFICATION IS MED BR VSL CL SA

SIEVE ANALYSIS

| SIEVE NUMBER | #CUM WT RETAINED | PERCENT FINER |
|---|---|---|
| 4 | 6.2 | 98.6 |
| 8 | 13.7 | 97.0 |
| 16 | 23.7 | 94.8 |
| 30 | 47.4 | 89.6 |
| 50 | 254.5 | 44.4 |
| 100 | 402.0 | 12.1 |
| 200 | 417.8 | 8.7 |

GRAIN SIZE DISTRIBUTION
1.4% GRAVEL 90.0% SAND 8.7% FINES
UNIFORMITY COEF = 26.26 COEF OF CURVATURE = 4.37

LAW ENGINEERING TESTING COMPANY
SOIL SAMPLE DATA

PROJECT NAME & NO. ARE EBASCO SERVICES, INC. 705.502
BORING NUMBER IS BS-2
SAMPLE IDENTIFICATION IS MED BR VSL CL SA

SIEVE ANALYSIS

| SIEVE NUMBER | #CUM WT RETAINED | PERCENT FINER |
|---|---|---|
| 4 | 10.3 | 98.6 |
| 8 | 23.6 | 96.8 |
| 16 | 38.3 | 94.8 |
| 30 | 74.9 | 89.8 |
| 50 | 400.8 | 45.4 |
| 100 | 653.2 | 11.0 |
| 200 | 673.1 | 8.3 |

GRAIN SIZE DISTRIBUTION
1.4% GRAVEL 90.3% SAND 8.3% FINES
UNIFORMITY COEF = 22.52 COEF OF CURVATURE = 3.99

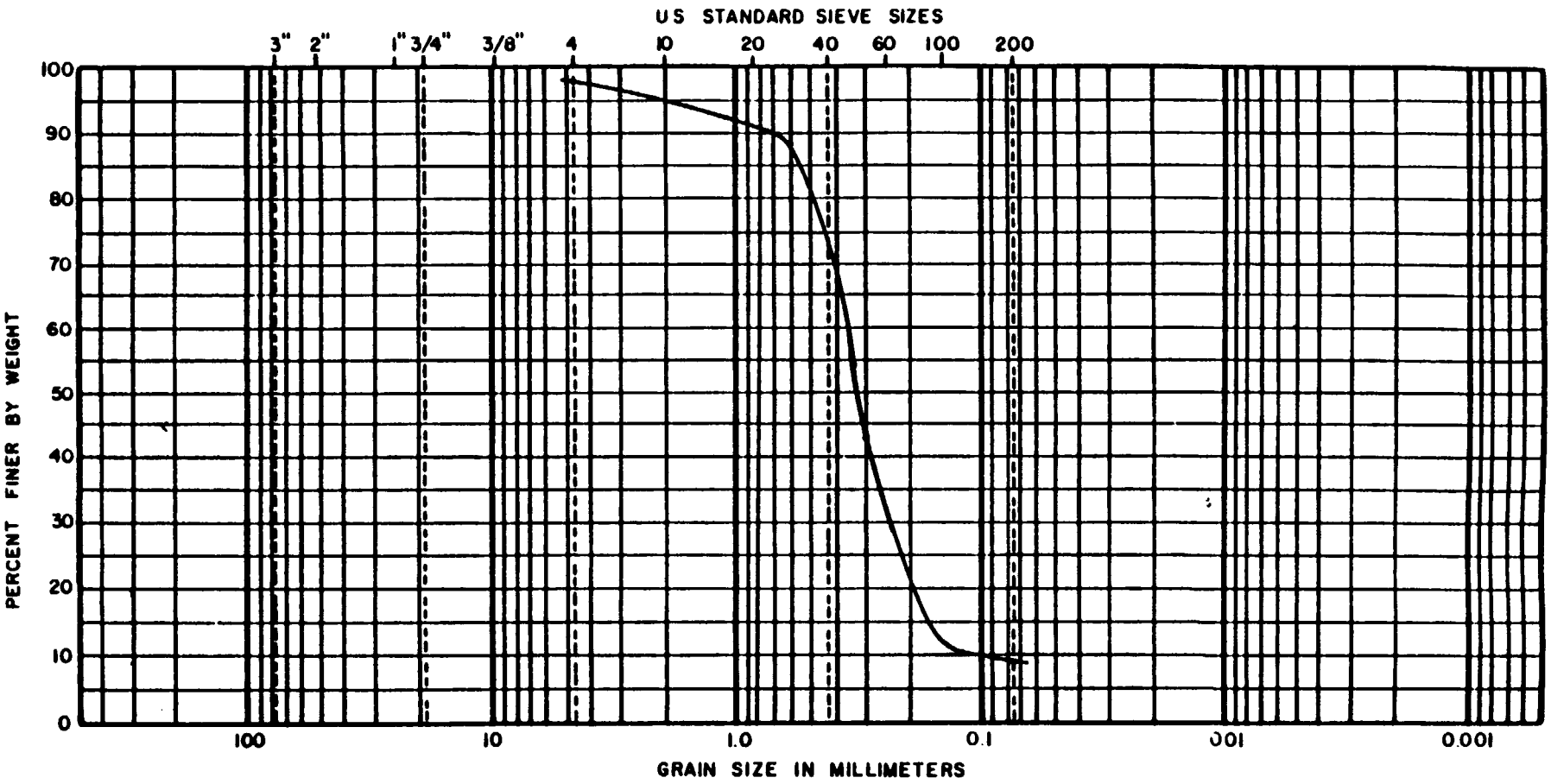
LAW ENGINEERING TESTING COMPANY
SOIL SAMPLE DATA

PROJECT NAME & NO. ARE EBASCO SERVICES,INC. 705.502
BORING NUMBER IS BS-3
SAMPLE IDENTIFICATION IS MED BR VSL CL SA

SIEVE ANALYSIS

| SIEVE NUMBER | #CUM WT RETAINED | PERCENT FINER |
|---|---|---|
| 4 | 13.9 | 97.9 |
| 8 | 27.8 | 95.9 |
| 16 | 42.5 | 93.7 |
| 30 | 76.5 | 88.6 |
| 50 | 366.1 | 45.7 |
| 100 | 583.7 | 13.4 |
| 200 | 604.7 | 10.2 |

GRAIN SIZE DISTRIBUTION
2.1% GRAVEL 87.7% SAND 10.2% FINES



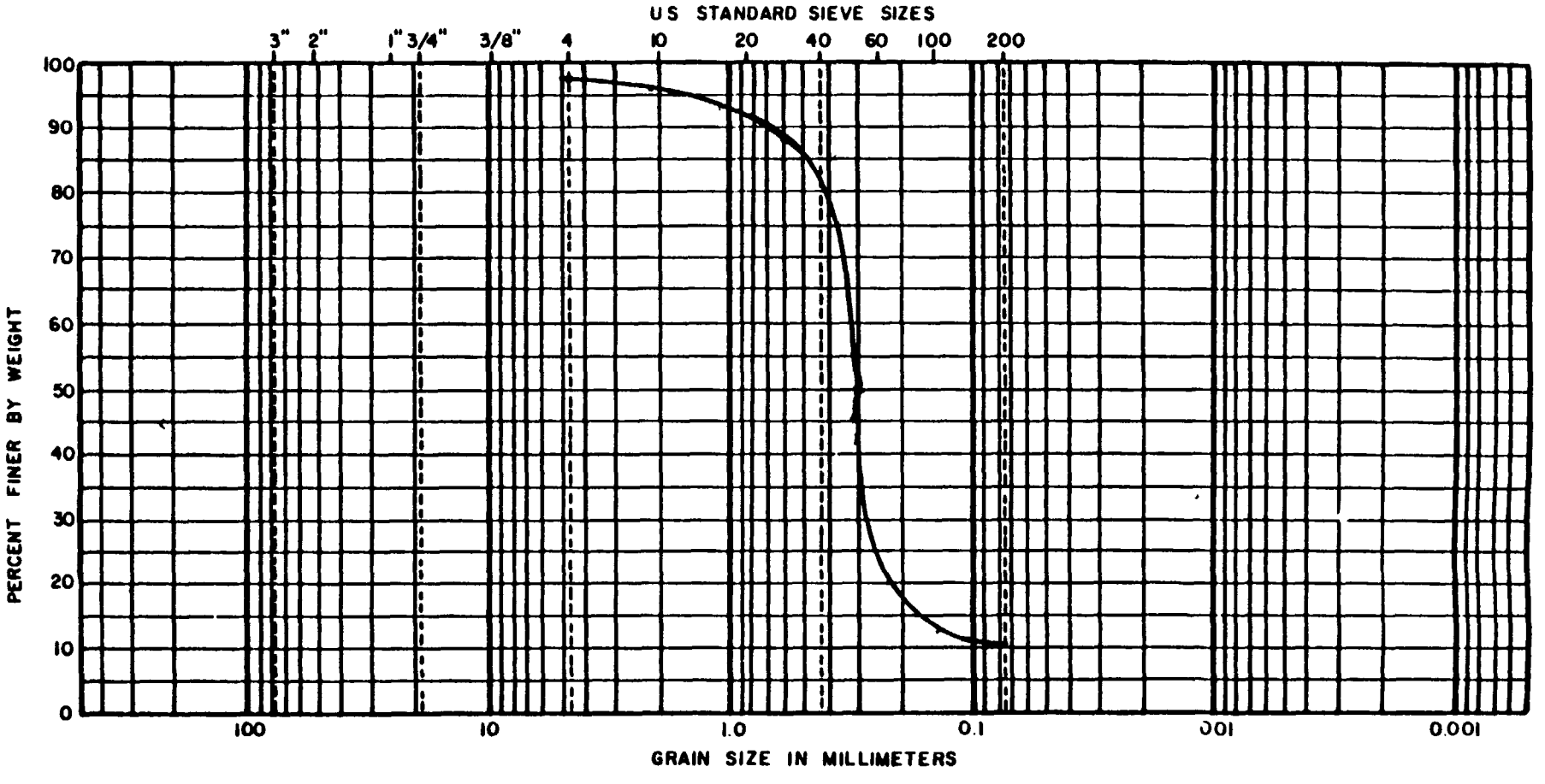

| BOULDERS | COBBLES | GRAVEL | | SAND | | | FINES | |
|---|---|---|---|---|---|---|---|---|
| | | COARSE | FINE | COARSE | MEDIUM | FINE | SILT SIZES | CLAY SIZES |

| | | |
|---|---|---|
| BORING NO. | Bag Sample | DESCRIPTION OR CLASSIFICATION |
| DEPTH OR ELEV. | | Medium Brown Sand |
| MOISTURE % | | |
| LIQUID LIMIT | | |
| PLASTIC LIMIT | | |
| PLASTICITY INDEX | | |

# GRAIN SIZE DISTRIBUTION

JOB NO. 705.87.502

LAW ENGINEERING TESTING COMPANY




| BOULDERS | COBBLES | GRAVEL | | SAND | | | FINES | |
|---|---|---|---|---|---|---|---|---|
| | | COARSE | FINE | COARSE | MEDIUM | FINE | SILT SIZES | CLAY SIZES |

| | |
|---|---|
| BORING NO. | Bag Sample 3 |
| DEPTH OR ELEV. | |
| MOISTURE % | |
| LIQUID LIMIT | |
| PLASTIC LIMIT | |
| PLASTICITY INDEX | |

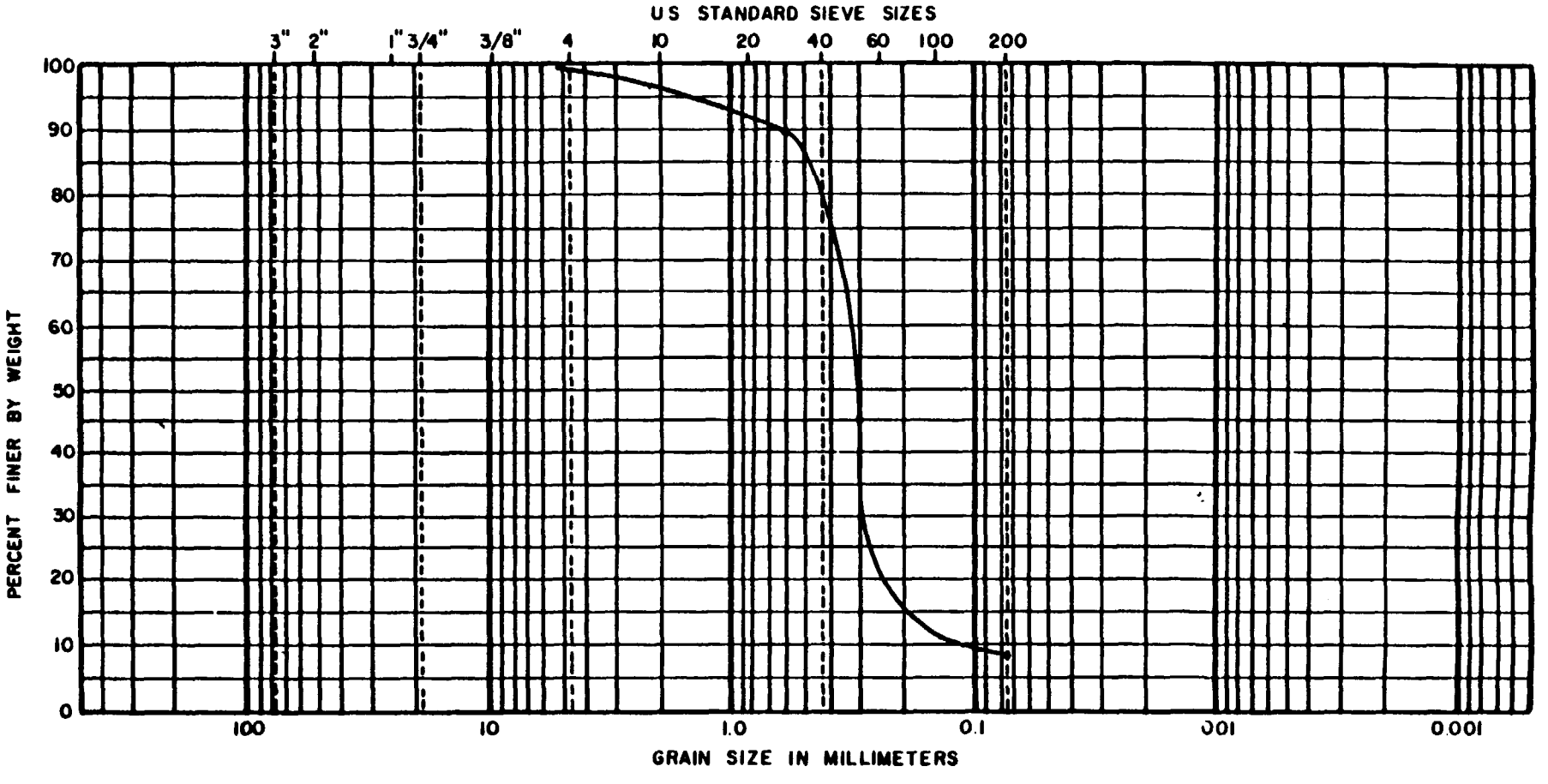
DESCRIPTION OR CLASSIFICATION

Medium Brown SAND

# GRAIN SIZE DISTRIBUTION

JOB NO. 705.87.502

LAW ENGINEERING TESTING COMPANY




| BOULDERS | COBBLES | GRAVEL | | SAND | | | FINES | |
|---|---|---|---|---|---|---|---|---|
| | | COARSE | FINE | COARSE | MEDIUM | FINE | SILT SIZES | CLAY SIZES |

| | |
|---|---|
| BORING NO. | Bag Sample 2 |
| DEPTH OR ELEV. | |
| MOISTURE % | |
| LIQUID LIMIT | |
| PLASTIC LIMIT | |
| PLASTICITY INDEX | |

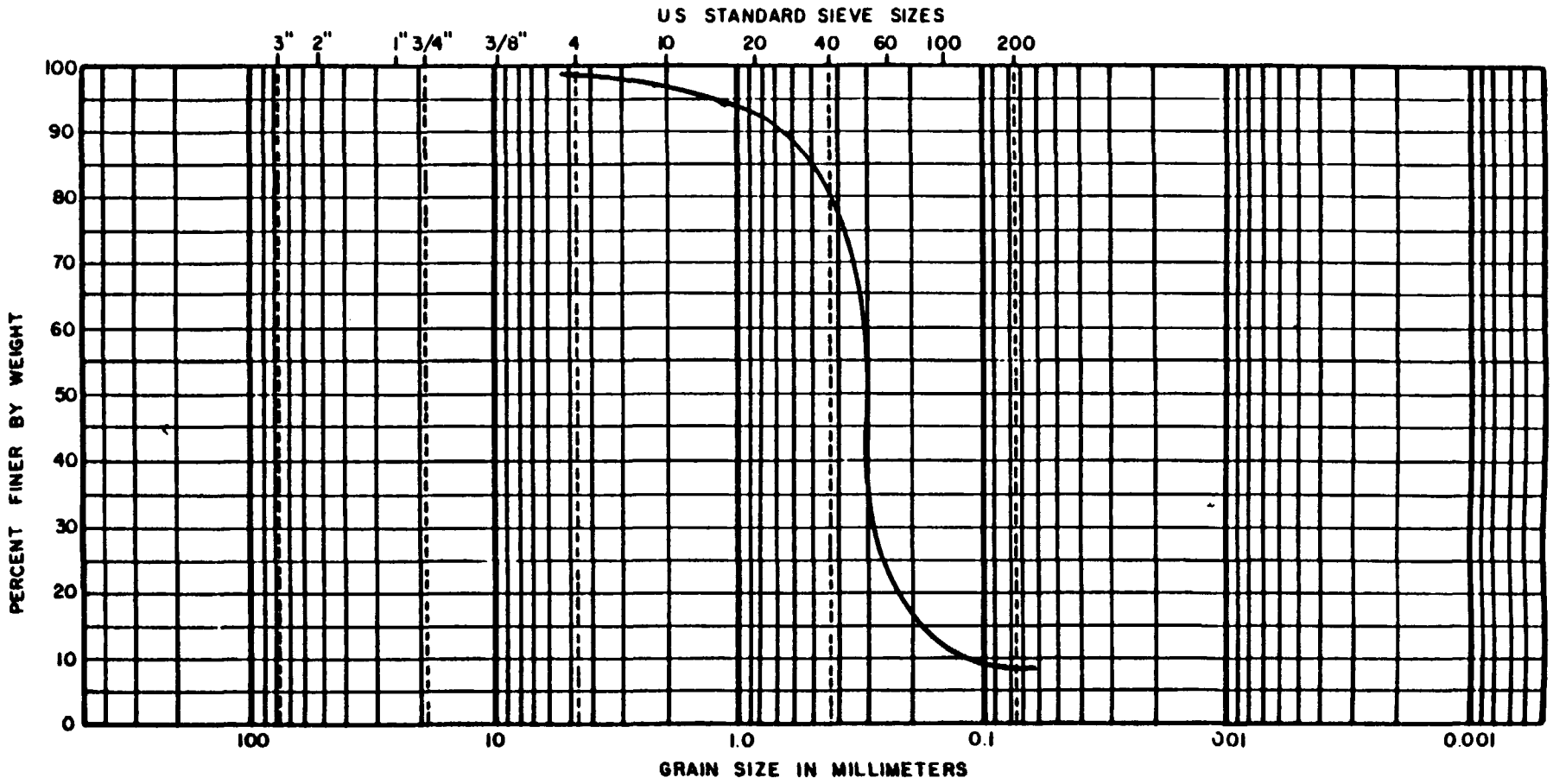
DESCRIPTION OR CLASSIFICATION

Medium Brown SAND

# GRAIN SIZE DISTRIBUTION

JOB NO. 705.87.502

LAW ENGINEERING TESTING COMPANY




| BOULDERS | COBBLES | GRAVEL | | SAND | | | FINES | |
|---|---|---|---|---|---|---|---|---|
| | | COARSE | FINE | COARSE | MEDIUM | FINE | SILT SIZES | CLAY SIZES |

| | |
|---|---|
| BORING NO. | Bag Sample 1 |
| DEPTH OR ELEV. | |
| MOISTURE % | |
| LIQUID LIMIT | |
| PLASTIC LIMIT | |
| PLASTICITY INDEX | |

DESCRIPTION OR CLASSIFICATION

Medium Brown SAND

# GRAIN SIZE DISTRIBUTION

JOB NO. 705.87.502

LAW ENGINEERING TESTING COMPANY

EBASCO SERVICES INCORPORATED

CALCULATION COVER SHEET

CLIENT: EPA

PROJECT: LEE'S LANE LANDFILL, JEFFERSON COUNTY, KENTUCKY

SUBJECT: GRAIN SIZE ANALYSIS & ATTERBURG LIMITS OF SOIL

OFS. NO. 4236.721 DEPT. 503

CALCULATION NO. 6 NUMBER OF SHEETS 18
(including this sheet)

SUPERSEDES CALC. NO. N/A

| REV. NO. | REVISION DESCRIPTION | CALC BY Name*/Date | CHECKED BY Name*/Date |
|---|---|---|---|
| 0 | NOT APPLICABLE | NUS CORPORATION 5/27/87 | |
| | | | |
| | | | |
| | | | |

* FULL SIGNATURE (FIRST NAME, INITIAL AND LAST NAME)

# EBASCO SERVICES INCORPORATED
## REM III PROGRAM CHAIN OF CUSTODY AND TRAFFIC RECORD

| | | | |
|---|---|---|---|
| EBASCO Charge Number: EPA 14 2 3 6 7 2 1<br>Site Name/Code: Lee's Land Landfill Superfund Site | Sampling Firm: EBASCO SERV.<br>Sampling Contact: A. O'Rear<br>(Name)<br>(404) 662-2207<br>(Phone) | Ship To: NUS CORPORATION<br>5350 Campbells Run Rd<br>Pittsburgh, PA 15205<br>Attn: Joanne Cosgrove | Shipping Information:<br>DHL<br>Name of Carrier<br>5/22/87<br>Date Shipped<br>1367030<br>Airbill Number |

Samplers (Signature)

| Sample No. | Date | Time | Station/Location | No. of Containers | Analytical protocol: Gen'l Inorg / Hydrocarbons | REMARKS |
|---|---|---|---|---|---|---|
| P-01 | 5/18/87 | 16:16 | TP-5 (0-6") | 1 | X | |
| P-02 | 5/20/87 | 12:28 | TP11 (0-6") | 1 | X | |
| P-03 | 5/20/87 | 12:24 | TP-12 (0-6") | 1 | X | |
| P-04 | 5/20/87 | 12:02 | TP-13 (0-6") | 1 | X | |
| P-05 | 5/20/87 | 10:50 | 75'N of TP-14 (0-6") | 1 | X | |
| P-06 | 5/20/87 | 10:20 | 50'W of TP-15 (0-6") | 1 | X | |
| P-07 | 5/20/87 | 10:05 | 50'W of TP-16 (0-6") | 1 | X | |
| P-08 | 5/20/87 | 9:50 | TP-17 (0-6") | 1 | X | |
| | | | | | | |
| | | | | | | |

| Relinquished by (Signature) | Date | Time | Received by (Signature) | Relinquished by (Signature) | Date | Time | Received by (Signature) |
|---|---|---|---|---|---|---|---|
| A. O'Rear | 5/22/87 | 1630 / 1630 | DHL | | | | |
| Relinquished by (Signature) | Date | Time | Received by (Signature) 5/26 10am Mary Stefanosky | Relinquished by (Signature) | Date | Time | Received by (Signature) |
| Relinquished by (Signature) | Date | Time | Received for Laboratory by (Signature) 5/26 10am Mary Stefanosky | Date | Time | Remarks: | |

Distribution: Original Accompanies Shipment; Second Copy to RLSC Files; Third Copy to Project File

NUS CORPORATION
A Halliburton Company

# GRAIN SIZE ANALYSIS & ATTERBURG LIMITS OF SOIL

Project No. FBASCO Lab No. 17051297
Project
Test Bore TP-5 Sample Depth 0-6"
Date Received Date Tested 5/27
Tested By
Checked By

## ATTERBERG LIMITS & N.M.C.

| | N.M.C. | | LL. | P.L. | P.L. | |
|---|---|---|---|---|---|---|
| Container No. | D-1 | | | | | |
| Wt Sample & Tare Wet | | | | | | |
| Wt. Sample & Tare Dry | 483.8 | | | | | |
| Wt. of Water | | | | | | |
| Wt. of Tare | 117.9 | | | | | |
| Wt. of Dry Soil | 365.9 | | | | | |
| Percent Moisture | | | | | | |

N.M.C. = % N = LL. = PL. = PI. = (LL-PL) =

CLASSIFICATION:

AASHO:
UNIFIED:

H1 102.44

## GRAIN SIZE ANALYSIS: Total Dried Sample Wt. = 365.9 (gm

Coarse Fraction

| Particle Size (mm) | Sieve Size | Retained of WT Weight (gm.) | Retained of WT Percent | Cumulative of WT % Retained | Cumulative of WT % Pass |
|---|---|---|---|---|---|
| 19.0 | 3/4" | 0.0 | | | |
| 12.7 | 1/2" | 0.0 | | | |
| 9.52 | 3/8" | 0.0 | | | 100.0 |
| 4.76 | No. 4 | 0.2 | 0.1 | 0.1 | 99.9 |
| 2.00 | No. 10 | 1.0 | ~~2.70.3~~ | 0.4 | 99.6 |

Fine Fraction

| Particle Size(mm) | Sieve Size | Retained of $W_1$ Weight (gm) | Retained of $W_1$ Percent | Cumulative of $W_1$ % Retained | Cumulative of $W_1$ % Passing | Cumulative of N- % Retained * | Cumulative of N- % Passing ** |
|---|---|---|---|---|---|---|---|
| 0.420 | No. 40 | 0.3 | 0.6 | 0.6 | 99.4 | 0.4 | 99.6 |
| 0.250 | No. 60 | 1.0 | 2.0 | 2.6 | 97.4 | 2.6 | 97.6 |
| 0.074 | No. 200 | 5.0 | 10.0 | 12.6 | 87.4 | 12.5 | 87.1 |

## HYDROMETER ANALYSIS OF MATERIAL PASSING No. 10 SIEVE

HYDROMETER NO 152664 SP. GR. USED 2.65 SP GR. CORR., a 1 DRY SAMPLE Wt. = $W_1$ = 50.0 gm

| Time | Time Min. | Temp. °C | Original Hydro. Reading | Correction | Corrected Hydro. Reading R | % Passing 100 R a ÷ $W_1$ | Particle Size (mm) | Cumulative % Passing of N- |
|---|---|---|---|---|---|---|---|---|
| 9:00 am | | | | | | | | |
| 9:05 AM | 5 | 22 | 42 | 5.5 | 36.5 | 73.0 | .020 | 72.7 |
| 10:00 AM | 60 | 22 | 30 | 5.5 | 24.5 | 49.0 | .006 | 48.8 |
| 9:00 AM | 1440 | 20 | 17 | 5.9 | 11.1 | 22.2 | .001 | 22.1 |

* The cumulative percent passing the No. 10 Sieve of Wt = 100 x the respective percent retained of $W_1$

** The cumulative percent passing the No. 10 Sieve of Wt = 100 x the respective percent passing of $W_1$

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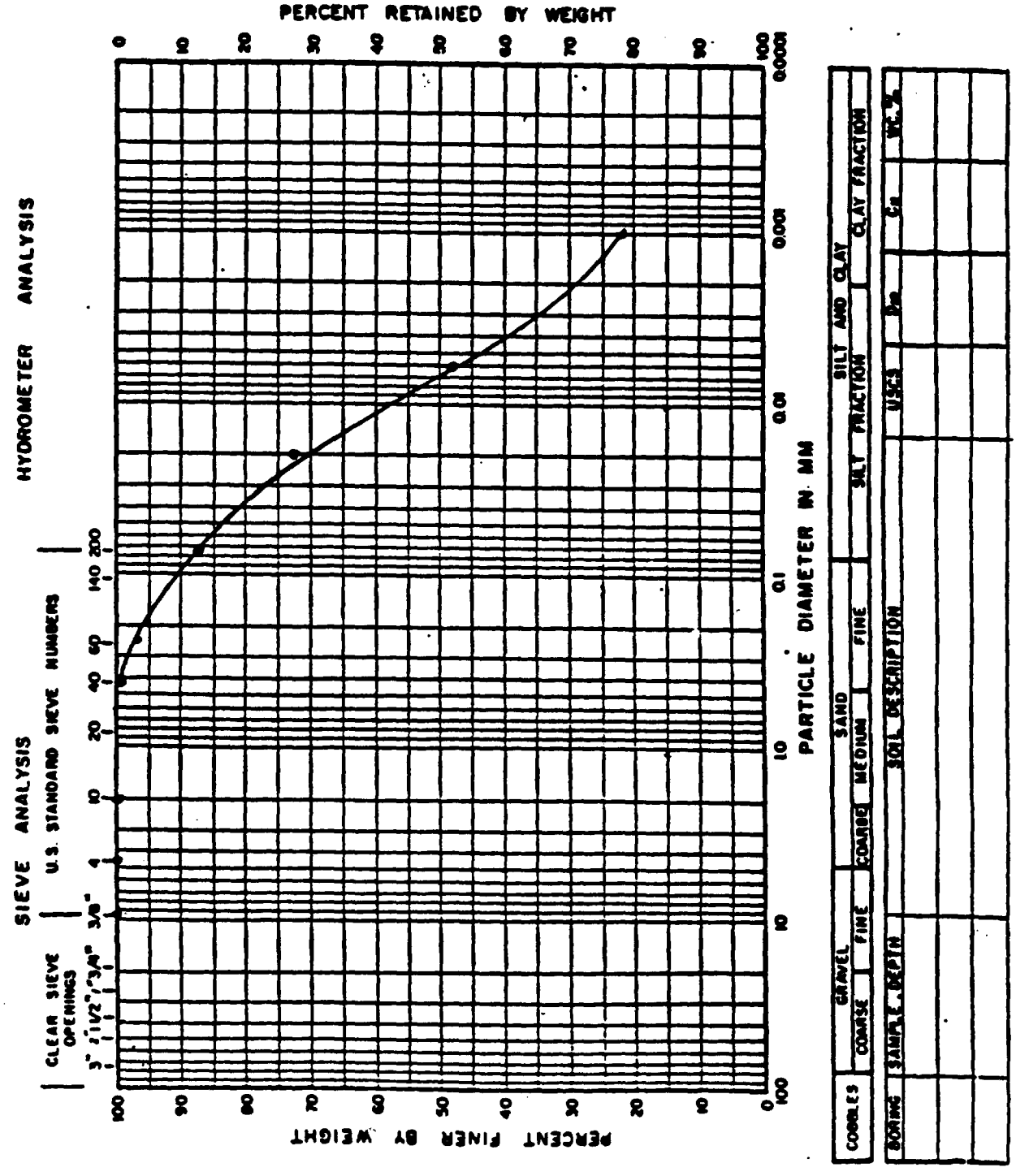
A Halliburton Company

Sheet _____ of _____

Project Name Edaco Project No. _____ Tested by JR date _____
oring/Test Pit No. TP-5 Sample No. _____ Calculated by JR date _____
ıple Depth 0-6" Sample Type _____ Checked by _____ date _____
Sample Description _____
ample Preparation Method _____

## GRAIN SIZE ANALYSIS
COHESIONLESS MATERIAL



NUS CORPORATION
A Halliburton Company

# GRAIN SIZE ANALYSIS & ATTERBURG LIMITS OF SOIL

Project No. EBASCO Lab No. 1705288
Project
Test Bore TP 1.1 Sample Depth 0-6"
Date Received Date Tested
Tested By
Checked By

## ATTERBERG LIMITS & N.M.C.

| | N.M.C. | | L.L. | P.L. | P.I. | |
|---|---|---|---|---|---|---|
| Container No. | D-3 | | | | | |
| Wt Sample & Tare Wet | | | | | | |
| Wt. Sample & Tare Dry | 510.3 | | | | | |
| Wt. of Water | | | | | | |
| Wt. of Tare | 119.4 | | | | | |
| Wt. of Dry Soil | 390.9 | | | | | |
| Percent Moisture | | | | | | |

N.M.C. = % N = L.L. = P.I. = P.I. = (L.L.-P.L.) =

CLASSIFICATION:

AASHO:

UNIFIED:

#2 100.54

## GRAIN SIZE ANALYSIS: Total Dried Sample Wt. = 390.9 (gm)

Coarse Fraction

| Particle Size (mm) | Sieve Size | Retained of WT Weight (gm.) | Retained of WT Percent | Cumulative of WT % Retained | Cumulative of WT % Pass |
|---|---|---|---|---|---|
| | | | | | |
| 19.0 | 3/4" | 0.0 | | | |
| 12.7 | 1/2" | 0.0 | | | |
| 9.52 | 3/8" | 0.0 | | | |
| 4.76 | No. 4 | 0.0 | | | |
| 2.00 | No. 10 | 0.0 | 0.0 | 0.0 | 100.0 |
| | | | | | |

Fine Fraction

| Particle Size(mm) | Sieve Size | Retained of $W_1$ Weight (gm) | Retained of $W_1$ Percent | Cumulative of $W_1$ % Retained | Cumulative of $W_1$ % Passing | Cumulative of $N$- % Retained * | Cumulative of $N$- % Passing ** |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 0.420 | No. 40 | 1.2 | 2.4 | 2.4 | 97.6 | 2.4 | 97.6 |
| 0.250 | No. 60 | 4.2 | 8.4 | 10.8 | 89.2 | 10.8 | 89.2 |
| | | | | | | | |
| 0.074 | No. 200 | 7.6 | 15.2 | 26.0 | 74 | 26.0 | 74.0 |
| | | | | | | | |

## HYDROMETER ANALYSIS OF MATERIAL PASSING No. 10 SIEVE

HYDROMETER NO 1063664 SP. GR. USED 2.65 SP GR. CORR., a 1 DRY SAMPLE Wt. = $W_1$ = 50.0 gm

| Time | Time Min. | Temp °C | Original Hydro. Reading | Correction | Corrected Hydro. Reading R | % Passing 100 R a ÷ $W_1$ | Particle Size (mm) | Cumulative % Passing of $N$- ** |
|---|---|---|---|---|---|---|---|---|
| 9:04 AM | | | | | | | | |
| | | | | | | | | |
| 9:09 AM | 5 | 22 | 29 | 5.5 | 23.5 | 47.0 | .022 | 47.0 |
| | | | | | | | | |
| 10:04 AM | 60 | 21.5 | 20.5 | 5.6 | 14.9 | 29.8 | .007 | 29.8 |
| | | | | | | | | |
| 9:04 AM | 1440 | 20 | 13 | 5.9 | 7.1 | 14.2 | .001 | 14.2 |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

* The cumulative percent passing the No. 10 Sieve of Wt = 100 x the respective percent retained of $W_1$

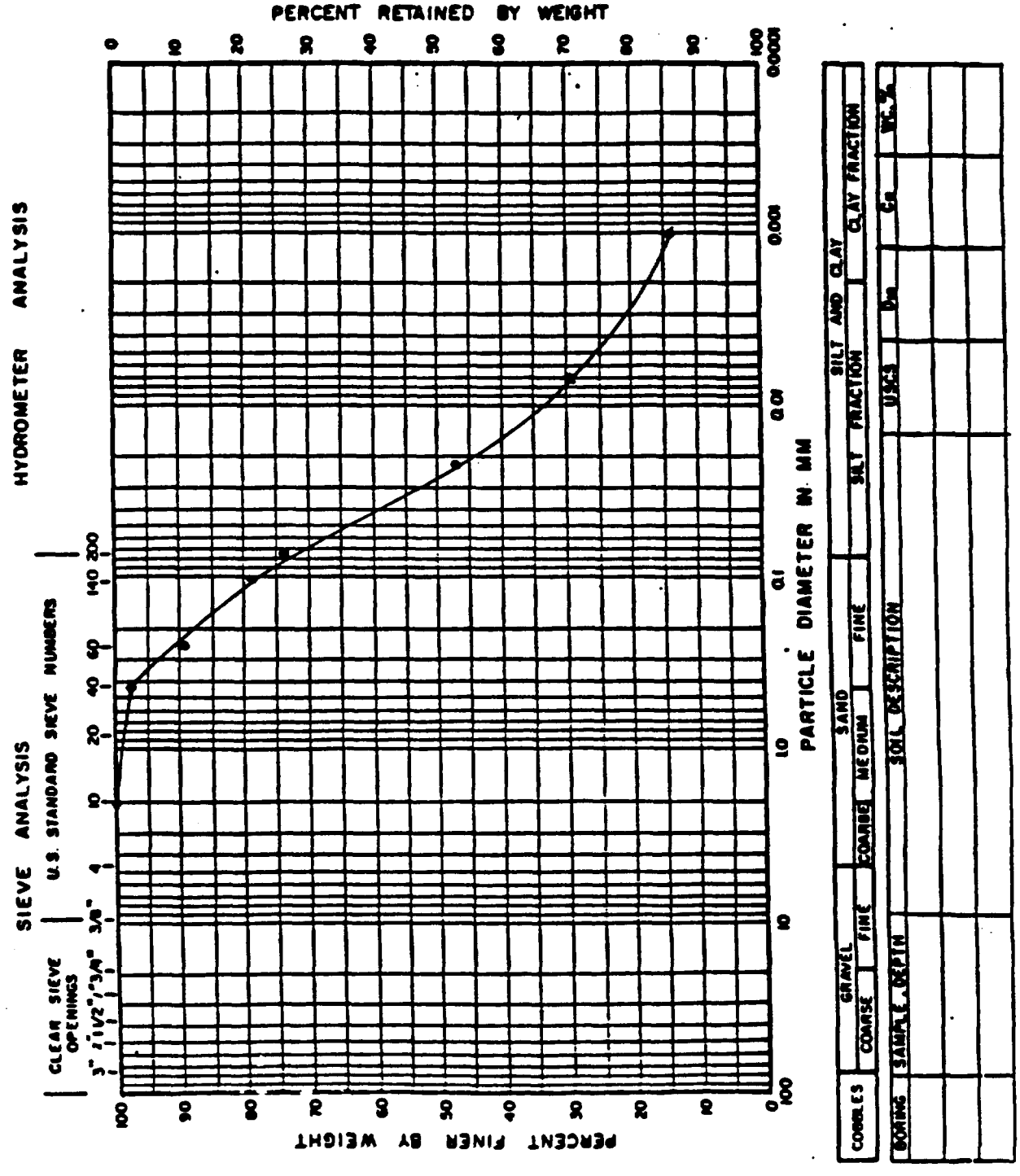
** The cumulative percent passing the No. 10 Sieve of Wt = 100 x the respective percent passing of $W_1$

IVD CORPORATION
A Halliburton Company

Laboratory No. 170-1298
Sheet ____ of ____

Project Name Ebasco Project No. ____ Tested by JR date ____
Boring/Test Pit No. TP-11 Sample No. ____ Calculated by JR date ____
Sample Depth 0-6" Sample Type ____ Checked by ____ date ____
Sample Description ____
Sample Preparation Method ____

## GRAIN SIZE ANALYSIS
COHESIONLESS MATERIAL



NUS CORPORATION
A Halliburton Company

# GRAIN SIZE ANALYSIS & ATTERBURG LIMITS OF SOIL

Project No. EBASCO Lab No. 170ST299
Project
Test Bore TP-03 Sample Depth 0-6"
Date Received Date Tested
Tested By
Checked By

## ATTERBERG LIMITS & N.M.C.

| | N.M.C. | | L.L. | P.L. | P.L. | |
|---|---|---|---|---|---|---|
| Container No. | A-2 | | | | | |
| Wt Sample & Tare Wet | | | | | | |
| Wt. Sample & Tare Dry | 678.9 | | | | | |
| Wt. of Water | | | | | | |
| Wt. of Tare | 117.9 | | | | | |
| Wt. of Dry Soil | 561.0 | | | | | |
| Percent Moisture | | | | | | |

N.M.C. = % N = L.L. = P.L. = P.I. = (L.L.-P.L.) =

CLASSIFICATION:

AASHO:
UNIFIED:

13 95.82

## GRAIN SIZE ANALYSIS: Total Dried Sample Wt. = 561.0 (gm)

Coarse Fraction

| Particle Size (mm) | Sieve Size | Retained of WT. Weight (gm.) | Retained of WT. Percent | Cumulative of WT. % Retained | Cumulative of WT. % Passing |
|---|---|---|---|---|---|
| 19.0 | 3/4" | 0.0 | 0.0 | 0.0 | 100.0 |
| 12.7 | 1/2" | 3.4 | 0.6 | 0.6 | 99.4 |
| 9.52 | 3/8" | 5.2 | 0.9 | 1.5 | 98.5 |
| 4.76 | No. 4 | 6.8 | 1.2 | 2.7 | 97.3 |
| 2.00 | No. 10 | 11.2 | 2.0 | 4.7 | 95.3 |

Fine Fraction

| Particle Size(mm) | Sieve Size | Retained of $W_1$ Weight (gm) | Retained of $W_1$ Percent | Cumulative of $W_1$ % Retained | Cumulative of $W_1$ % Passing | Cumulative of $N-$ % Retained * | Cumulative of $N-$ % Passing ** |
|---|---|---|---|---|---|---|---|
| 0.420 | No. 40 | 5.7 | 11.4 | 11.4 | 88.6 | 10.9 | 84.4 |
| 0.250 | No. 60 | 11.5 | 23.0 | 34.4 | 65.6 | 32.8 | 62.5 |
| 0.074 | No. 200 | 12.7 | 25.4 | 59.6 | 40.2 | 57.0 | 38.3 |

## HYDROMETER ANALYSIS OF MATERIAL PASSING No. 10 SIEVE

HYDROMETER NO. 06364 SP. GR. USED 2.65 SP GR. CORR., a 1 DRY SAMPLE Wt. = $W_1$ = 50.0 gm

| Time | Time Min. | Temp. °C | Original Hydro. Reading | Correction | Corrected Hydro. Reading R | % Passing 100 R a ÷ $W_1$ | Particle Size (mm) | Cumulative % Passing of $W_1$ ** |
|---|---|---|---|---|---|---|---|---|
| 9:08 AM | | | | | | | | |
| 9:13 AM | 5 | 22 | 19 | 5.5 | 13.5 | 27.0 | .013 | ~~27.0~~ 25.7 |
| 10:08 AM | 60 | 21.5 | 15 | 5.6 | 9.4 | 18.8 | .007 | ~~18.8~~ 17.9 |
| 9:08 AM | 1440 | 20 | 10.5 | 5.9 | 4.6 | 9.2 | .001 | ~~9.2~~ 8.8 |

* The cumulative percent passing the No. 10 Sieve of $W_T$ = 100 x the respective percent retained of $W_1$

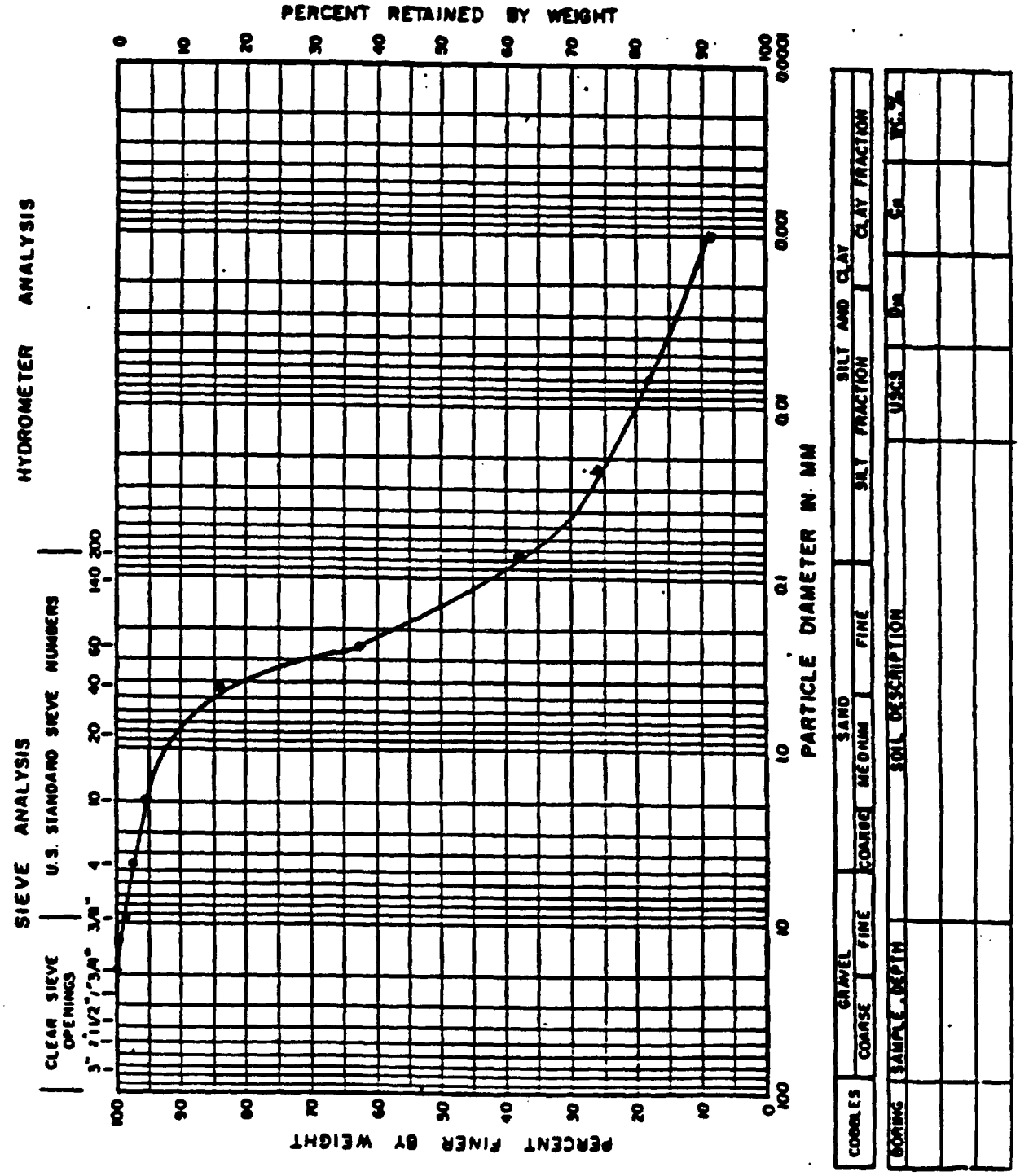
** The cumulative percent passing the No. 10 Sieve of $W_T$ = 100 x the respective percent passing of $W_1$

IWG CORPORATION
A Halliburton Company

Laboratory No. [illegible]
Sheet ____ of ____

Project Name Ebosco Project No. ____ Tested by JR date ____
Boring/Test Pit No. TP-03 Sample No. ____ Calculated by JR date ____
Sample Depth 0-6" Sample Type ____ Checked by ____ date ____
Sample Description ____
Sample Preparation Method ____

## GRAIN SIZE ANALYSIS
COHESIONLESS MATERIAL



NUS CORPORATION
A Halliburton Company

# GRAIN SIZE ANALYSIS & ATTERBURG LIMITS OF SOIL

Project No. EBASCO Lab No. 1705/300
Project
Test Bore TP-13 Sample Depth 0-6"
Date Received Date Tested
Tested By
Checked By

## ATTERBERG LIMITS & N.M.C.

| | N.M.C. | | LL. | PL. | PL. | |
|---|---|---|---|---|---|---|
| Container No. | A-10 | | | | | |
| Wt Sample & Tare Wet | | | | | | |
| Wt. Sample & Tare Dry | 591.4 | | | | | |
| Wt. of Water | | | | | | |
| Wt. of Tare | 119.4 | | | | | |
| Wt. of Dry Soil | 472.0 | | | | | |
| Percent Moisture | | | | | | |

N.M.C. = % N = L.L. = P.L. = P.I. = (L.L.-P.L.) =

CLASSIFICATION:

AASHO:

UNIFIED:

99.79

GRAIN SIZE ANALYSIS: Total Dried Sample Wt. = 472.0 (gm)

Coarse Fraction

| Particle Size (mm) | Sieve Size | Retained of WT Weight (gm.) | Retained of WT Percent | Cumulative of WT % Retained | Cumulative of WT % Pass. |
|---|---|---|---|---|---|
| 19.0 | 3/4" | 0.0 | | | |
| 12.7 | 1/2" | 0.0 | | | |
| 9.52 | 3/8" | 0.0 | | | |
| 4.76 | No. 4 | 0.0 | 0.0 | 0.0 | 100.0 |
| 2.00 | No. 10 | 0.4 | 0.1 | 0.1 | 99.9 |

Fine Fraction

| Particle Size(mm) | Sieve Size | Retained of $W_1$ Weight (gm) | Retained of $W_1$ Percent | Cumulative of $W_1$ % Retained | Cumulative of $W_1$ % Passing | Cumulative of $N-$ % Retained * | Cumulative of $N-$ % Passing ** |
|---|---|---|---|---|---|---|---|
| 0.420 | No. 40 | 0.2 | 0.4 | 0.4 | 99.6 | 0.4 | 99.5 |
| 0.250 | No. 60 | 0.9 | 1.8 | 2.2 | 97.8 | 2.2 | 97.7 |
| 0.074 | No. 200 | 18.6 | 37.2 | 39.4 | 60.6 | 39.4 | 60.5 |

## HYDROMETER ANALYSIS OF MATERIAL PASSING No. 10 SIEVE

HYDROMETER NO. 263664 SP. GR. USED 2.65 SP GR. CORR., a 1 DRY SAMPLE Wt. = $W_1$ = 50.0 gm

| Time | Time Min. | Temp. °C | Original Hydro. Reading | Correction | Corrected Hydro. Reading R | % Passing 100 R a ÷ $W_1$ | Particle Size (mm) | Cumulative % Passing of $W-$ ** |
|---|---|---|---|---|---|---|---|---|
| 9:12 AM | | | | | | | | |
| 9:17 AM | 5 | 22 | 21 | 5.5 | 15.5 | 31.0 | .023 | 31.0 |
| 10:12 AM | 60 | 21.5 | 16 | 5.6 | 10.4 | 20.8 | .007 | 20.8 |
| 9:12 AM | 1440 | 20 | 11 | 5.9 | 5.1 | 10.2 | .001 | 10.2 |

* The cumulative percent passing the No. 10 Sieve of $W_T$ = 100 x the respective percent retained of $W_1$

** The cumulative percent passing the No. 10 Sieve of $W_T$ = 100 x the respective percent passing of $W_1$

A Halliburton Company

Sheet ____ of ____

Project Name Ebasco Project No. ____ Tested by JR date ____

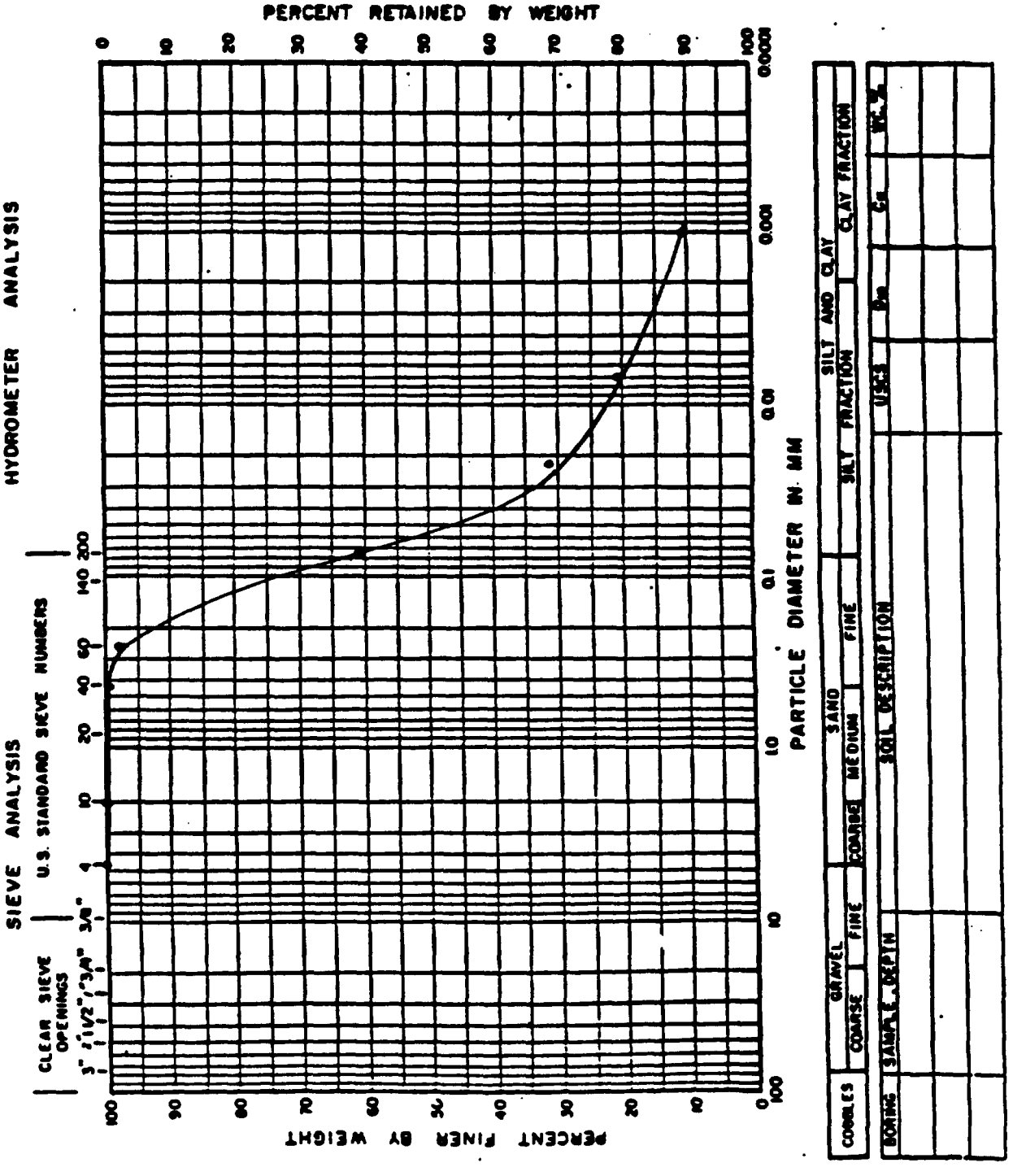
Boring/Test Pit No. TP-13 Sample No. ____ Calculated by JR date ____

Sample Depth 0-6" Sample Type ____ Checked by ____ date ____

Sample Description ____

Sample Preparation Method ____

## GRAIN SIZE ANALYSIS
### COHESIONLESS MATERIAL



NUS CORPORATION
A Halliburton Company

# GRAIN SIZE ANALYSIS & ATTERBURG LIMITS OF SOIL

Project No. EBASCO Lab No. 1705130
Project
Test Bore TP-14 Sample Depth 0-6.1'
Date Received Date Tested
Tested By
Checked By

## ATTERBERG LIMITS & N.M.C.

| | N.M.C. | | LL. | P.L. | P.L. | |
|---|---|---|---|---|---|---|
| Container No. | C-3 | | | | | |
| Wt. Sample & Tare Wet | | | | | | |
| Wt. Sample & Tare Dry | 551.7 | | | | | |
| Wt. of Water | | | | | | |
| Wt. of Tare | 118.7 | | | | | |
| Wt. of Dry Soil | 433.0 | | | | | |
| Percent Moisture | | | | | | |

N.M.C. = % N= LL= PL= PI = (LL-PL) =

CLASSIFICATION:

AASHO=
UNIFIED=

92.64

## GRAIN SIZE ANALYSIS: Total Dried Sample Wt. = 433.0 (gm)

Coarse Fraction

| Particle Size (mm) | Sieve Size | Retained of WT Weight (gm.) | Retained of WT Percent | Cumulative of WT % Retained | Cumulative of WT % Pass |
|---|---|---|---|---|---|
| 19.0 | 3/4" | 0.0 | | | |
| 12.7 | 1/2" | 0.0 | | | |
| 9.52 | 3/8" | 0.0 | 0.0 | 0.0 | 100.0 |
| 4.76 | No. 4 | 0.5 | 0.1 | 0.1 | 99.9 |
| 2.00 | No. 10 | 2.5 | 0.6 | 0.7 | 99.3 |

Fine Fraction

| Particle Size(mm) | Sieve Size | Retained of $W_1$ Weight (gm) | Retained of $W_1$ Percent | Cumulative of $W_1$ % Retained | Cumulative of $W_1$ % Passing | Cumulative of N- % Retained * | Cumulative of N- % Passing ** |
|---|---|---|---|---|---|---|---|
| 0.420 | No. 40 | 0.7 | 1.4 | 1.4 | 98.6 | 1.4 | 97.9 |
| 0.250 | No. 60 | 1.1 | 2.2 | 3.6 | 96.4 | 3.6 | 95.7 |
| 0.074 | No. 200 | 13.2 | 26.4 | 30.0 | 70.0 | 29.8 | 68.5 |

## HYDROMETER ANALYSIS OF MATERIAL PASSING No. 10 SIEVE

HYDROMETER NO. 152H SP. GR. USED 2.65 SP. GR. CORR., a 1 DRY SAMPLE Wt. = $W_1$ = 50.0 gm

| Time | Time Min. | Temp. °C | Original Hydro. Reading | Correction | Corrected Hydro. Reading R | % Passing 100 R a ÷ $W_1$ | Particle Size (mm) | Cumulative % Passing of N** |
|---|---|---|---|---|---|---|---|---|
| 9:16 AM | | | | | | | | |
| 9:21 AM | 5 | 22 | 31 | 5.5 | 25.5 | 51.0 | .021 | 50.6 |
| 10:16 AM | 60 | 22 | 21.5 | 5.5 | 16 | 32.0 | .007 | 31.8 |
| 9:16 AM | 1440 | 20 | 12 | ~~5.5~~ 5.9 | ~~4.5~~ 6.1 | ~~9.0~~ 12.2 | .001 | ~~20~~ 12.1 |

* The cumulative percent passing the No. 10 Sieve of Wt = 100 x the respective percent retained of $W_1$

** The cumulative percent passing the No. 10 Sieve of Wt = 100 x the respective percent passing of $W_1$

INDOT CORPORATION
A Halliburton Company

Laboratory No. 1705-301

Sheet ____ of ____

Project Name Ebasco Project No. ____ Tested by JR date ____

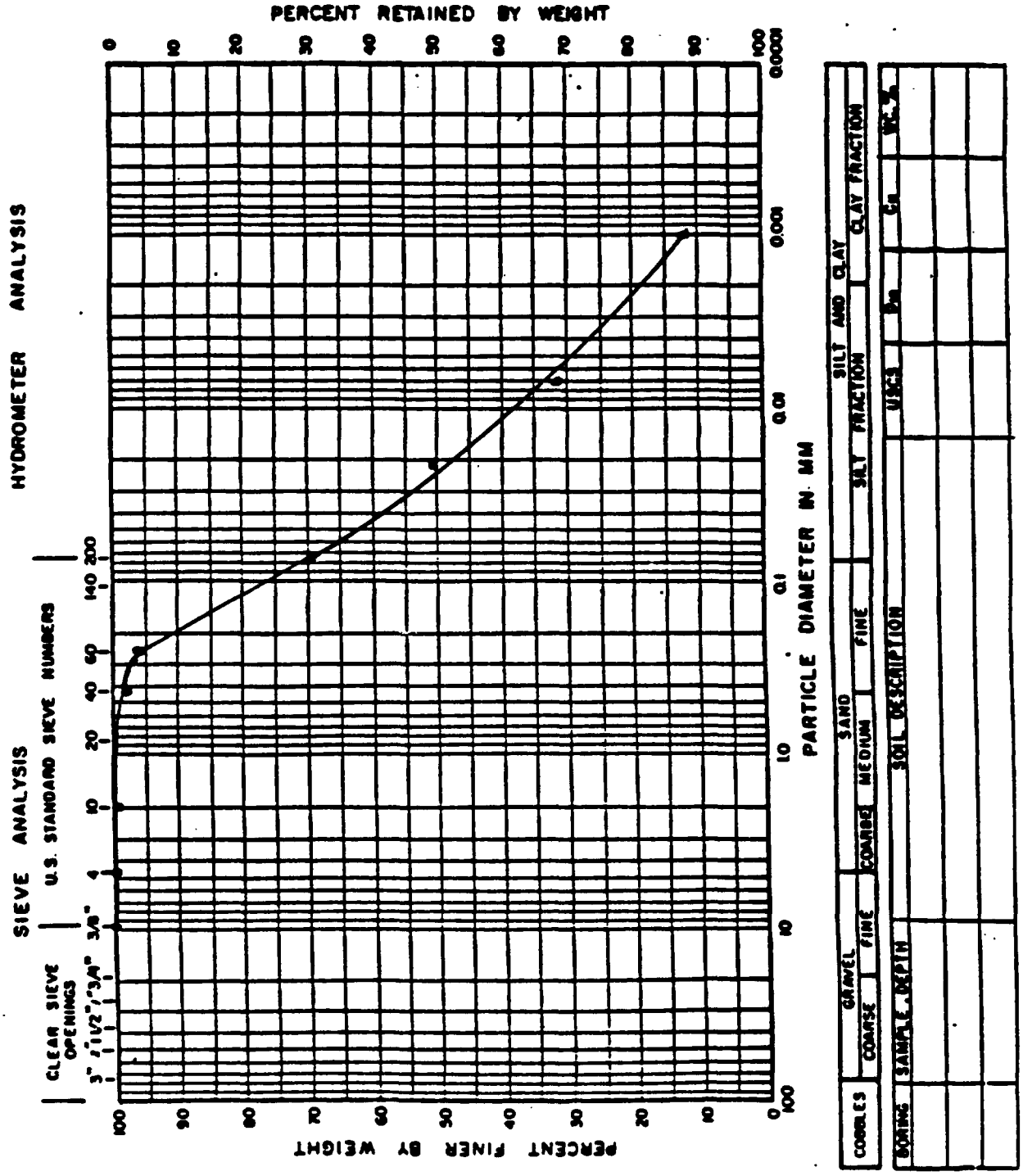
Boring/Test Pit No. TP #14 Sample No. ____ Calculated by JR date ____

Sample Depth 0-6" Sample Type ____ Checked by ____ date ____

Sample Description ____

Sample Preparation Method ____

## GRAIN SIZE ANALYSIS
### COHESIONLESS MATERIAL



NUS CORPORATION
A Halliburton Company

# GRAIN SIZE ANALYSIS & ATTERBURG LIMITS OF SOIL

Project No. 7B1500 Lab No. 1705/302
Project
Test Bore T.P. # 15 Sample Depth 0'-6"
Date Received Date Tested
Tested By
Checked By

## ATTERBERG LIMITS & N.M.C.

| | N.M.C. | | LL. | P.L. | P.L. | |
|---|---|---|---|---|---|---|
| Container No. | B-7 | | | | | |
| Wt. Sample & Tare Wet | | | | | | |
| Wt. Sample & Tare Dry | 647.8 | | | | | |
| Wt. of Water | | | | | | |
| Wt. of Tare | 120.9 | | | | | |
| Wt. of Dry Soil | 526.9 | | | | | |
| Percent Moisture | | | | | | |

N.M.C. = % N = LL. = PI. = PI. = (LL-PL) =

CLASSIFICATION:

AASHO:

UNIFIED:

394.71

## GRAIN SIZE ANALYSIS - Total Dried Sample Wt. = 526.7 (gm)

Coarse Fraction

| Particle Size (mm) | Sieve Size | Retained of WT Weight (gm.) | Retained of WT Percent | Cumulative of WT % Retained | Cumulative of WT % Pass |
|---|---|---|---|---|---|
| | | | | | |
| 19.0 | 3/4" | 0.0 | 0.0 | 0.0 | 100.0 |
| 12.7 | 1/2" | 6.8 | 1.3 | 1.3 | 98.7 |
| 9.52 | 3/8" | 4.3 | 0.8 | 2.1 | 97.9 |
| 4.76 | No. 4 | 8.4 | 1.6 | 3.7 | 96.3 |
| 2.00 | No. 10 | 7.0 | 1.3 | 5.0 | 95.0 |
| | | | | | |

Fine Fraction

| Particle Size(mm) | Sieve Size | Retained of $W_1$ Weight (gm) | Retained of $W_1$ Percent | Cumulative of $W_1$ % Retained | Cumulative of $W_1$ % Passing | Cumulative of $N-$ % Retained * | Cumulative of $N-$ % Passing ** |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 0.420 | No. 40 | 2.2 | 4.4 | 4.4 | 95.6 | 4.2 | 90.8 |
| 0.250 | No. 60 | 3.6 | 7.2 | 11.6 | 88.4 | 11.0 | 84.6 |
| | | | | | | | |
| 0.074 | No. 200 | 18.4 | 36.8 | 48.4 | 51.6 | 46.0 | 49.0 |
| | | | | | | | |

## HYDROMETER ANALYSIS OF MATERIAL PASSING No. 10 SIEVE

HYDROMETER NO. 163664 SP. GR. USED 2.65 SP. GR. CORR., a 1 DRY SAMPLE Wt. = $W_1$ = 50.0 gm

| Time | Time Min. | Temp. °C | Original Hydro. Reading | Correction | Corrected Hydro. Reading R | % Passing 100 R a ÷ $W_1$ | Particle Size (mm) | Cumulative % Passing of $W_1$ ** |
|---|---|---|---|---|---|---|---|---|
| 9:20 AM | | | | | | | | |
| | | | | | | | | |
| 9:25 AM | 5 | 22 | 22 | 5.5 | 16.5 | 33.0 | .023 | 31.4 |
| | | | | | | | | |
| 10:20 AM | 60 | 22 | 18 | 5.5 | 12.5 | 25.0 | .007 | 23.8 |
| | | | | | | | | |
| 9:20 AM | 1440 | 20 | 12 | 5.9 | 6.1 | 12.2 | .002 | 11.6 |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

* The cumulative percent passing the No. 10 Sieve of $W_1$ = 100 x the respective percent retained of $W_1$

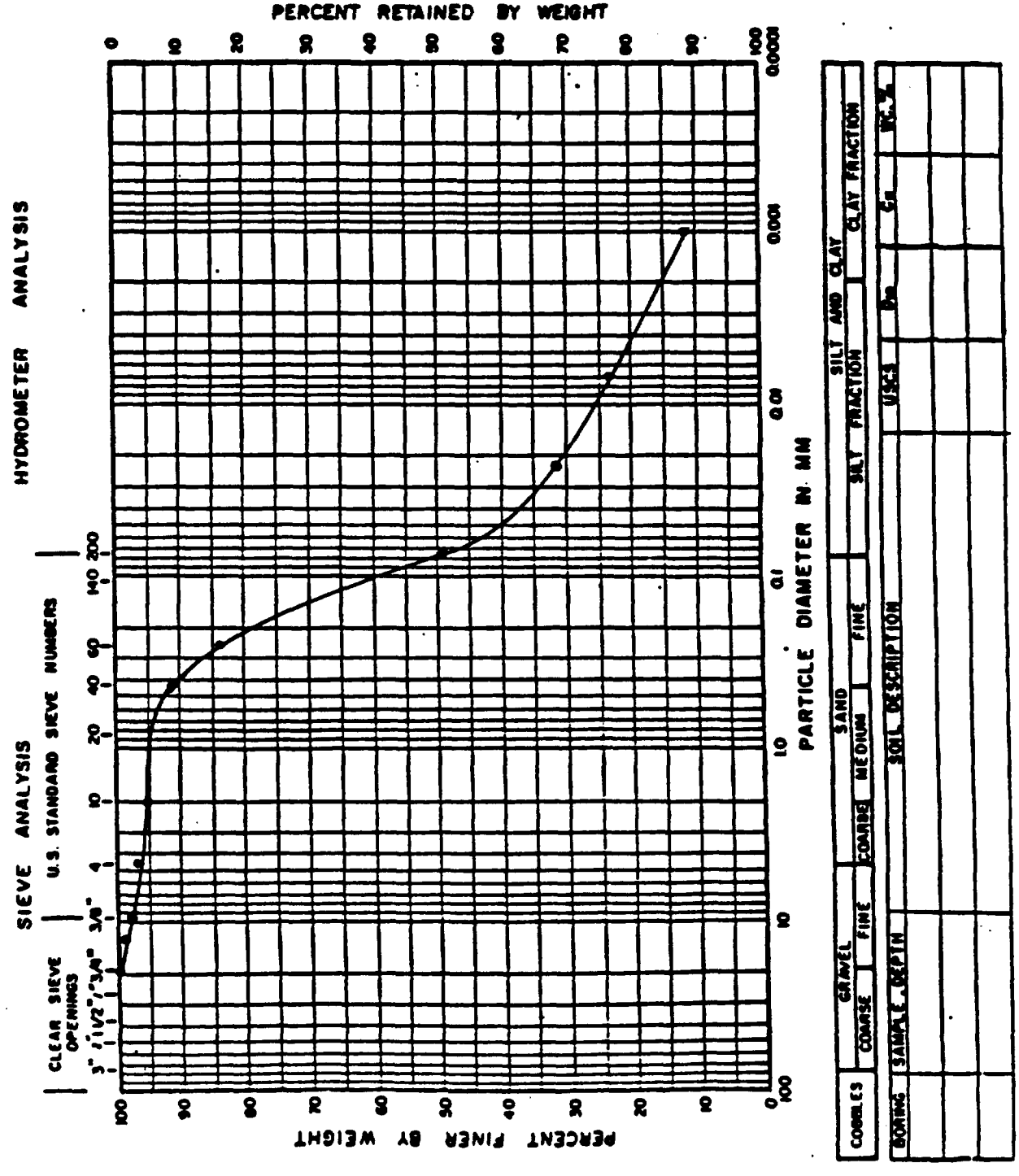
** The cumulative percent passing the No. 10 Sieve of $W_1$ = 100 x the respective percent passing of $W_1$

INJ CORPORATION
A Halliburton Company

Laboratory No. [illegible]
Sheet ____ of ____

Project Name Edosco Project No. ____ Tested by JR date ____
Boring/Test Pit No. TP #13 Sample No. ____ Calculated by JR date ____
Sample Depth 0-6" Sample Type ____ Checked by ____ date ____
Sample Description ____
Sample Preparation Method ____

## GRAIN SIZE ANALYSIS
COHESIONLESS MATERIAL



NUS CORPORATION
A Halliburton Company

# GRAIN SIZE ANALYSIS & ATTERBURG LIMITS OF SOIL

Project No. EBASCO Lab No. 17057303
Project
Test Bore TP # 16 Sample Depth 0-6"
Date Received Date Tested
Tested By
Checked By

## ATTERBERG LIMITS & N.M.C.

| | N.M.C. | | L.L. | P.L. | P.L. | |
|---|---|---|---|---|---|---|
| Container No. | C-5 | | | | | |
| Wt Sample & Tare Wet | | | | | | |
| Wt. Sample & Tare Dry | 574.5 | | | | | |
| Wt. of Water | | | | | | |
| Wt. of Tare | 118.1 | | | | | |
| Wt. of Dry Soil | 456.4 | | | | | |
| Percent Moisture | | | | | | |

N.M.C. = % N = L.L. = P.L. = P.I. = (L.L.-P.L.) =

CLASSIFICATION:

AASHO:
UNIFIED:

#7 95.67

## GRAIN SIZE ANALYSIS: Total Dried Sample Wt. = 456.4 (gm)

Coarse Fraction

| Particle Size (mm) | Sieve Size | Retained of Wt. Weight (gm.) | Retained of Wt. Percent | Cumulative of WT % Retained | Cumulative of WT % Pass |
|---|---|---|---|---|---|
| 19.0 | 3/4" | 0.0 | 0.0 | | |
| 12.7 | 1/2" | 0.0 | 0.0 | | |
| 9.52 | 3/8" | 0.0 | 0.0 | 0.0 | 100.0 |
| 4.76 | No. 4 | 1.7 | 0.4 | 0.4 | 99.6 |
| 2.00 | No. 10 | ~~5.4~~ 5.5 | 1.2 | 1.6 | 98.4 |

Fine Fraction

| Particle Size(mm) | Sieve Size | Retained of $W_1$ Weight (gm) | Retained of $W_1$ Percent | Cumulative of $W_1$ % Retained | Cumulative of $W_1$ % Passing | Cumulative of $W_r$ % Retained * | Cumulative of $W_r$ % Passing ** |
|---|---|---|---|---|---|---|---|
| 0.420 | No. 40 | 1.6 | 3.2 | 3.2 | 96.8 | 3.1 | 95.3 |
| 0.250 | No. 60 | 1.5 | 3.0 | 6.2 | 93.8 | 6.1 | 92.3 |
| 0.074 | No. 200 | 13.4 | 26.8 | 33.0 | 67.0 | 32.5 | 65.7 |

## HYDROMETER ANALYSIS OF MATERIAL PASSING No. 10 SIEVE

HYDROMETER NO. 1063669 SP. GR. USED 2.65 SP. GR. CORR., a 1 DRY SAMPLE Wt. = $W_1$ = 50.0 gm

| Time | Time Min. | Temp. °C | Original Hydro. Reading | Correction | Corrected Hydro. Reading R | % Passing 100 R a ÷ $W_1$ | Particle Size (mm) | Cumulative % Passing of $W_r$ ** |
|---|---|---|---|---|---|---|---|---|
| 9:24 AM | | | | | | | | |
| 9:29 AM | 5 | 22 | 28 | 5.5 | 22.5 | 45.0 | .022 | 44.3 |
| 10:24 AM | 60 | 22 | 21 | 5.5 | 15.5 | 31.0 | .008 | 30.5 |
| 9:24 AM | 1440 | 20 | 12.5 | 5.9 | 6.6 | 13.2 | .003 | 13.0 |

* The cumulative percent passing the No. 10 Sieve of $W_r$ = 100 x the respective percent retained of $W_1$
** The cumulative percent passing the No. 10 Sieve of $W_r$ = 100 x the respective percent passing of $W_1$

INDOT CORPORATION
A Halliburton Company

Laboratory No. 7703703

Sheet ____ of ____

Project Name Ebasco Project No. ____ Tested by JR date ____

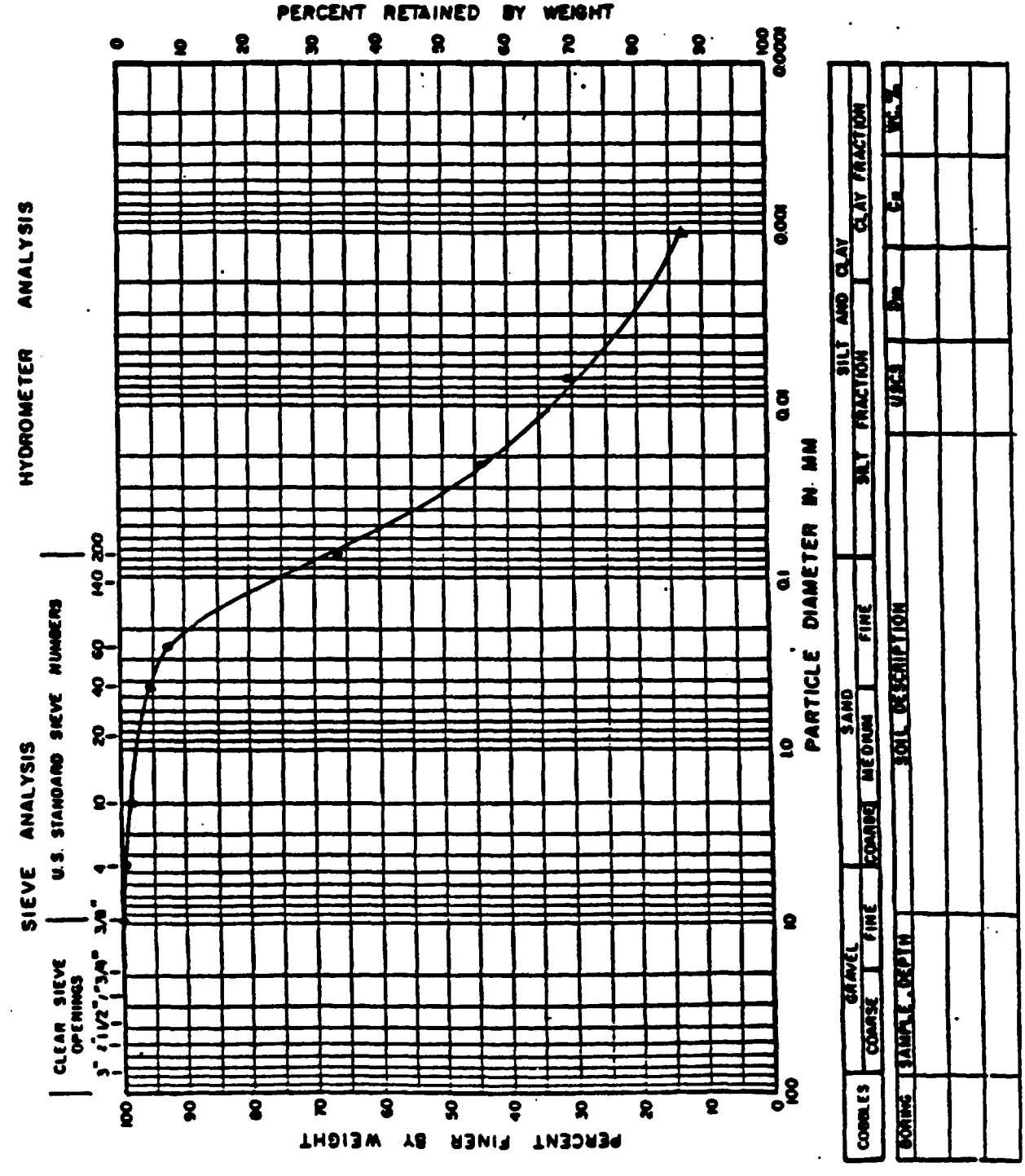
Boring/Test Pit No. TP # 16 Sample No. ____ Calculated by JR date ____

Sample Depth 0-6" Sample Type ____ Checked by ____ date ____

Sample Description ____

Sample Preparation Method ____

## GRAIN SIZE ANALYSIS
COHESIONLESS MATERIAL



NUS CORPORATION
A Halliburton Company

# GRAIN SIZE ANALYSIS & ATTERBURG LIMITS OF SOIL

Project No. BASCO Lab No. 17051304
Project
Test Bore TP 4.17 Sample Depth 0-6"
Date Received Date Tested
Tested By
Checked By

## ATTERBERG LIMITS & N.M.C.

| | N.M.C. | | LL. | P.L. | P.L. | |
|---|---|---|---|---|---|---|
| Container No. | A-7 | | | | | |
| Wt Sample & Tare Wet | | | | | | |
| Wt Sample & Tare Dry | 624.9 | | | | | |
| Wt. of Water | | | | | | |
| Wt. of Tare | 119.5 | | | | | |
| Wt. of Dry Soil | 505.4 | | | | | |
| Percent Moisture | | | | | | |

N.M.C. = % N = LL = PI = PI = (LL-PL) =

CLASSIFICATION:

AASHO:
UNIFIED:

#8 91.15

## GRAIN SIZE ANALYSIS

Total Dried Sample Wt. = 505.4

Coarse Fraction

| Particle Size (mm) | Sieve Size | Retained of Wt Weight (gm.) | Retained of Wt Percent | Cumulative % Retained | Cumulative of Wt % Passing |
|---|---|---|---|---|---|
| 19.0 | 3/4" | 0.0 | | | |
| 12.7 | 1/2" | 0.0 | | | |
| 9.52 | 3/8" | 0.0 | 0.0 | 0.0 | 100.0 |
| 4.76 | No. 4 | 1.2 | 0.2 | 0.2 | 99.8 |
| 2.00 | No. 10 | 1.8 | 0.4 | 0.6 | 99.4 |

Fine Fraction

| Particle Size(mm) | Sieve Size | Retained of $W_1$ Weight (gm) | Retained of $W_1$ Percent | Cumulative of $W_1$ % Retained | Cumulative of $W_1$ % Passing | Cumulative of $N_-$ % Retained * | Cumulative of $N_-$ % Passing** |
|---|---|---|---|---|---|---|---|
| 0.420 | No. 40 | 0.6 | 1.2 | 1.2 | 98.8 | 1.2 | 98.2 |
| 0.250 | No. 60 | 2.7 | 5.4 | 6.6 | 93.4 | 6.6 | 93.8 |
| 0.074 | No. 200 | 17.6 | 39.2 | 45.8 | 54.2 | 45.5 | 53.7 |

## HYDROMETER ANALYSIS OF MATERIAL PASSING No. 10 SIEVE

HYDROMETER NO. 106364 SP. GR. USED 2.65 SP GR CORR., a 1 DRY SAMPLE Wt. = $W_1$ = 50.0

| Time | Time Min. | Temp °C | Original Hydro. Reading | Correction | Corrected Hydro. Reading R | % Passing 100 R a ÷ $W_1$ | Particle Size (mm) | Cumulative % Passing |
|---|---|---|---|---|---|---|---|---|
| 9:26 AM | | | | | | | | |
| 9:33 AM | 5 | 22 | 23 | 5.5 | 17.5 | 35.0 | 0.032 | 34.8 |
| 10:28 AM | 60 | 22 | 18 | 5.5 | 12.5 | 25.0 | 0.013 | 24.8 |
| 9:28 AM | 1440 | 20 | 12 | 5.9 | 6.1 | 12.2 | 0.001 | 12.1 |

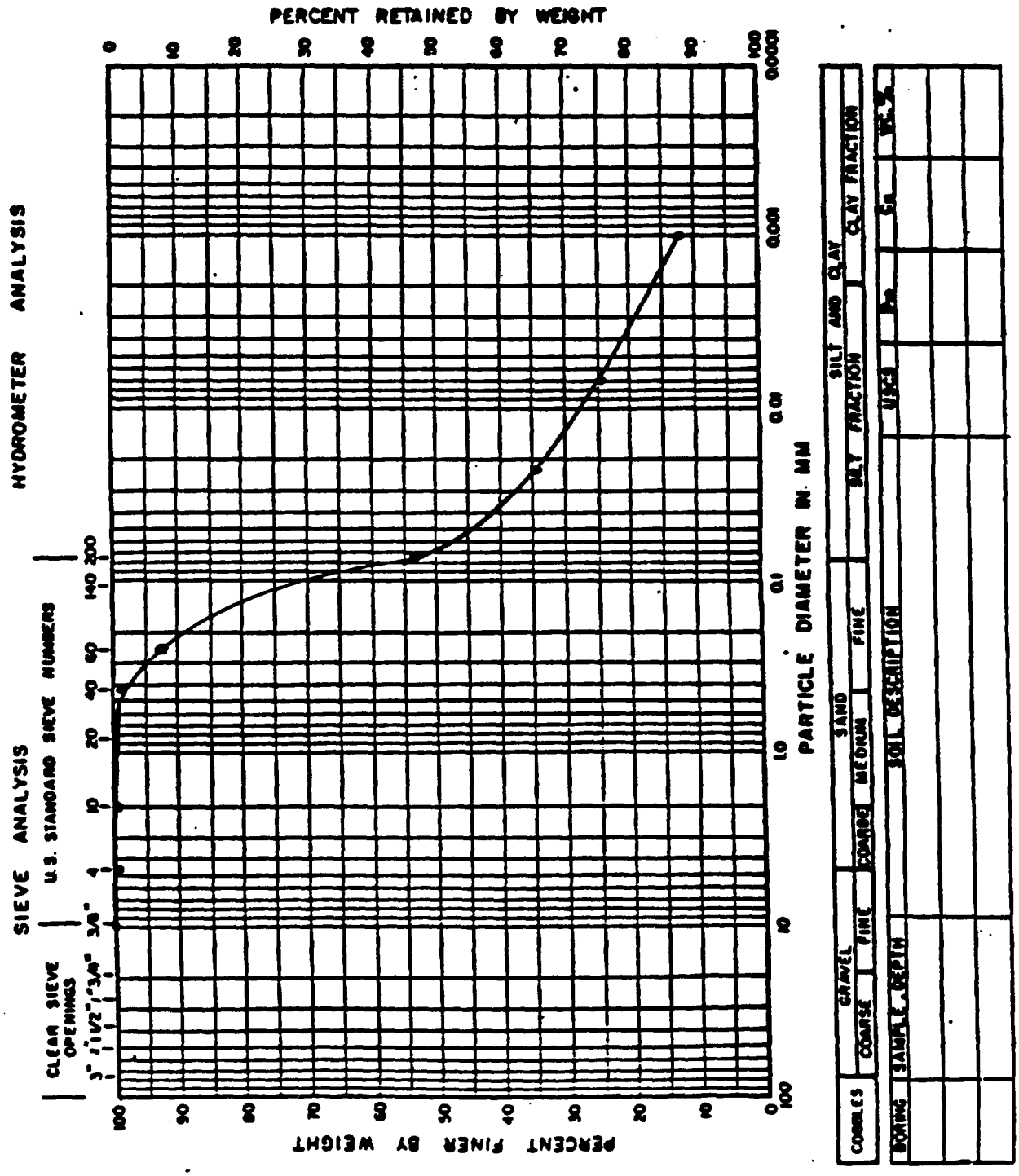
* The cumulative percent passing the No. 10 Sieve of Wt = 100 x the respective percent retained of $W_1$
** The cumulative percent passing the No. 10 Sieve of Wt = 100 x the respective percent passing of $W_1$

NUS CORPORATION
A Halliburton Company

Laboratory No. 1705304
Sheet ____ of ____

Project Name Ebosco Project No. ____ Tested by JR date ____
Boring/Test Pit No. TP #17 Sample No. ____ Calculated by JR date ____
Sample Depth 0-6" Sample Type ____ Checked by ____ date ____
Sample Description ____
Sample Preparation Method ____

# GRAIN SIZE ANALYSIS
## COHESIONLESS MATERIAL



EBASCO SERVICES INCORPORATED

CALCULATION COVER SHEET

CLIENT: EPA

PROJECT: LEE'S LANE LANDFILL, JEFFERSON COUNTY, KENTUCKY

SUBJECT: REPORT OF GRAIN SIZE TEST RESULTS

OFS. NO. 4236.721 DEPT. 503

CALCULATION NO. 7 NUMBER OF SHEETS 8
(including this sheet)

SUPERSEDES CALC. NO. N/A

| REV. NO. | REVISION DESCRIPTION | CALC BY Name*/Date | CHECKED BY Name*/Date |
|---|---|---|---|
| 0 | NOT APPLICABLE | LAW ENGINEERING 6/24/87 | |
| | | | |
| | | | |
| | | | |

* FULL SIGNATURE (FIRST NAME, INITIAL AND LAST NAME)

cc: Bob Howard - NY 7/7 ②

LAW ENGINEERING

GEOTECHNICAL, ENVIRONMENTAL
& CONSTRUCTION MATERIALS
CONSULTANTS

June 24, 1987

EBASCO Services, Inc
145 Technology Park
Atlanta, Georgia 30092
(404) 449-5800

Attention: Mr. Keith A. Kessler, P.E.

Subject: Report of Grain Size Test Results
Lees Lane Landfill
Louisville, Kentucky
Law Engineering Project No. 705.87.502

Gentlemen:

Law Engineering is pleased to submit the results of grain size tests for the Lees Lane project. Our services are provided in accordance with our Work Authorization Sheet dated June 19, 1987.

Three bag samples of sand bedding material were delivered to our office by Mr. Robert E. Howard of EBASCO Services, Incorporated. The samples were tested in accordance with ASTM D422, Particle - Size Analysis of Soils.

The test results are shown on the attached data sheets and Grain Size Distribution Curves.

If you have any questions concerning these test results, please contact me.

Sincerely,
Law Engineering

R. J. Mazzoni

Richard J. Mazzoni, P.E.
Construction Services Manager

RJM:dar

Attachments

11125 DECIMAL DRIVE
LOUISVILLE, KY 40299
502-267-4181

LAW ENGINEERING TESTING COMPANY
SOIL SAMPLE DATA

PROJECT NAME & NO. ARE EBASCO SERVICES LEES LANE PROJECT
BORING NUMBER IS Sample 1
SAMPLE IDENTIFICATION IS DARK BROWN SLIGHTLY SILTY SAND

SPECIFIC GRAVITY = 2.68
NATURAL MOISTURE CONTENT = 7.0 PERCENT

SIEVE ANALYSIS

| SIEVE NUMBER | #CUM WT RETAINED | PERCENT FINER |
|---|---|---|
| 4 | 9.6 | 98.7 |
| 8 | 22.7 | 97.0 |
| 16 | 38.9 | 94.9 |
| 30 | 76.3 | 90.0 |
| 50 | 412.8 | 45.7 |
| 100 | 653.2 | 14.1 |
| 200 | 679.3 | 10.6 |

PLASTICITY PROPERTIES OF MAT. PASSING NO. 40 SIEVE

SOIL SAMPLE IS NON-PLASTIC

GRAIN SIZE DISTRIBUTION
1.3% GRAVEL 88.1% SAND 10.6% FINES

LAW ENGINEERING TESTING COMPANY
SOIL SAMPLE DATA

PROJECT NAME & NO. ARE EBASCO SERVICES LEES LANE PROJECT
BORING NUMBER IS SAMPLE 2
SAMPLE IDENTIFICATION IS MEDIUM BROWN SLIGHTLY CLAYEY SAND

SPECIFIC GRAVITY = 2.68
NATURAL MOISTURE CONTENT = 9.6 PERCENT

SIEVE ANALYSIS

| SIEVE NUMBER | #CUM WT RETAINED | PERCENT FINER |
|---|---|---|
| 4 | 8.3 | 99.2 |
| 8 | 17.8 | 98.2 |
| 16 | 28.8 | 97.1 |
| 30 | 55.2 | 94.4 |
| 50 | 405.3 | 59.2 |
| 100 | 745.3 | 24.9 |
| 200 | 815.5 | 17.8 |

PLASTICITY PROPERTIES OF MAT. PASSING NO. 40 SIEVE

SOIL SAMPLE IS NON-PLASTIC

GRAIN SIZE DISTRIBUTION
.8% GRAVEL 81.3% SAND 17.8% FINES

UNIFIED SOIL CLASSIFICATION IS SM

LAW ENGINEERING TESTING COMPANY
SOIL SAMPLE DATA

PROJECT NAME & NO. ARE EBASCO SERVICES LEES LANE PROJECT
BORING NUMBER IS SAMPLE 3
SAMPLE IDENTIFICATION IS MEDIUM BROWN SLIGHTLY CLAYEY SAND

SPECIFIC GRAVITY = 2.68
NATURAL MOISTURE CONTENT = 9.6 PERCENT

SIEVE ANALYSIS

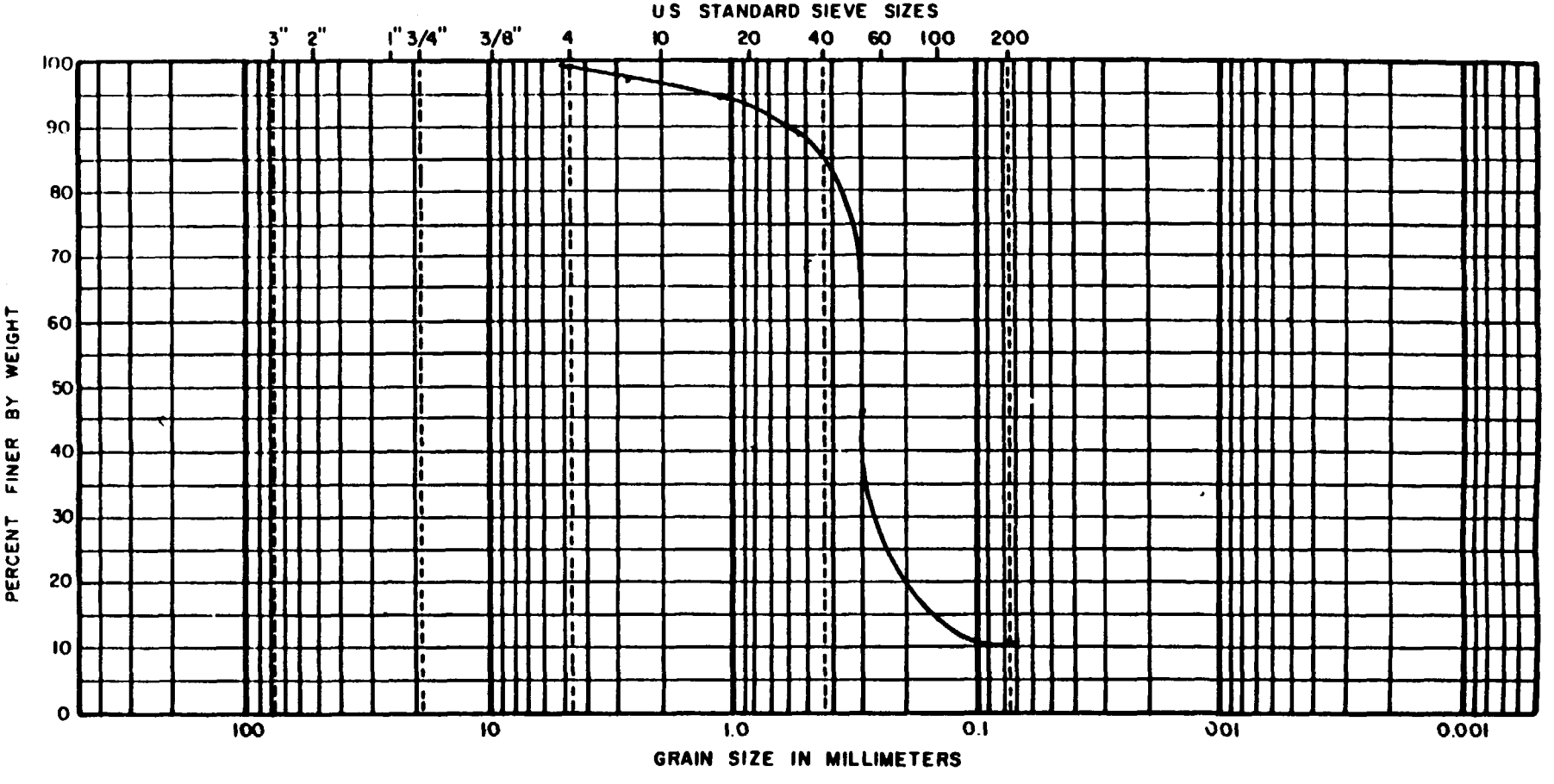
| SIEVE NUMBER | #CUM WT RETAINED | PERCENT FINER |
|---|---|---|
| 4 | 5.9 | 99.5 |
| 8 | 11.5 | 99.0 |
| 16 | 18.2 | 98.4 |
| 30 | 37.7 | 96.7 |
| 50 | 490.8 | 56.4 |
| 100 | 847.8 | 24.7 |
| 200 | 914.2 | 18.8 |

PLASTICITY PROPERTIES OF MAT. PASSING NO. 40 SIEVE

SOIL SAMPLE IS NON-PLASTIC

GRAIN SIZE DISTRIBUTION
.5% GRAVEL 80.6% SAND 18.8% FINES

UNIFIED SOIL CLASSIFICATION IS SM



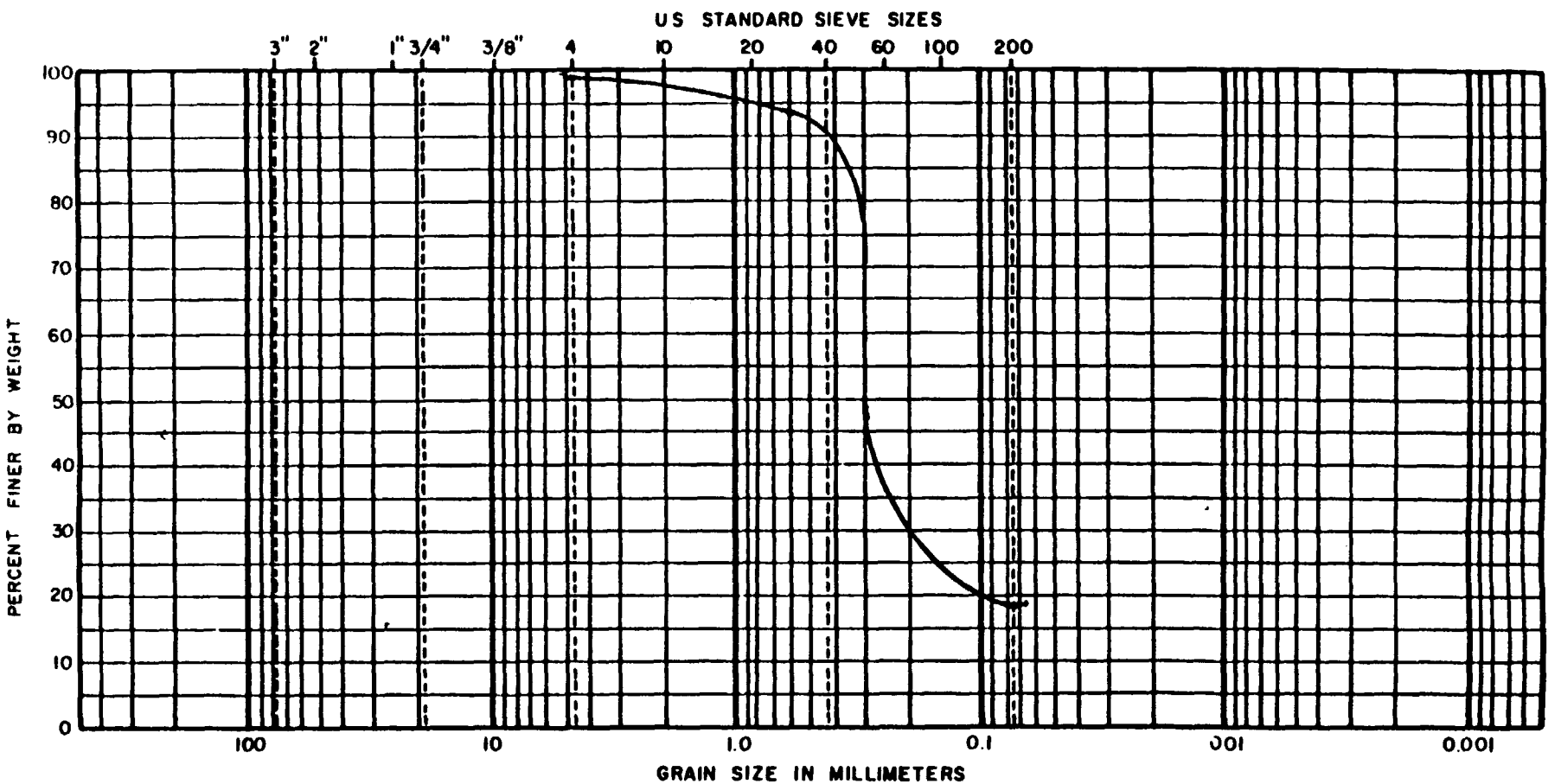

| BOULDERS | COBBLES | GRAVEL | | SAND | | | FINES | |
|---|---|---|---|---|---|---|---|---|
| | | COARSE | FINE | COARSE | MEDIUM | FINE | SILT SIZES | CLAY SIZES |

| | | |
|---|---|---|
| BORING NO. | Bag Sample 1 | DESCRIPTION OR CLASSIFICATION |
| DEPTH OR ELEV. | | Dark Brown Slightly Silty Sand |
| MOISTURE % | 7.0 | |
| LIQUID LIMIT | | |
| PLASTIC LIMIT | | |
| PLASTICITY INDEX | | |

# GRAIN SIZE DISTRIBUTION

JOB NO. 705.87.502

LAW ENGINEERING TESTING COMPANY



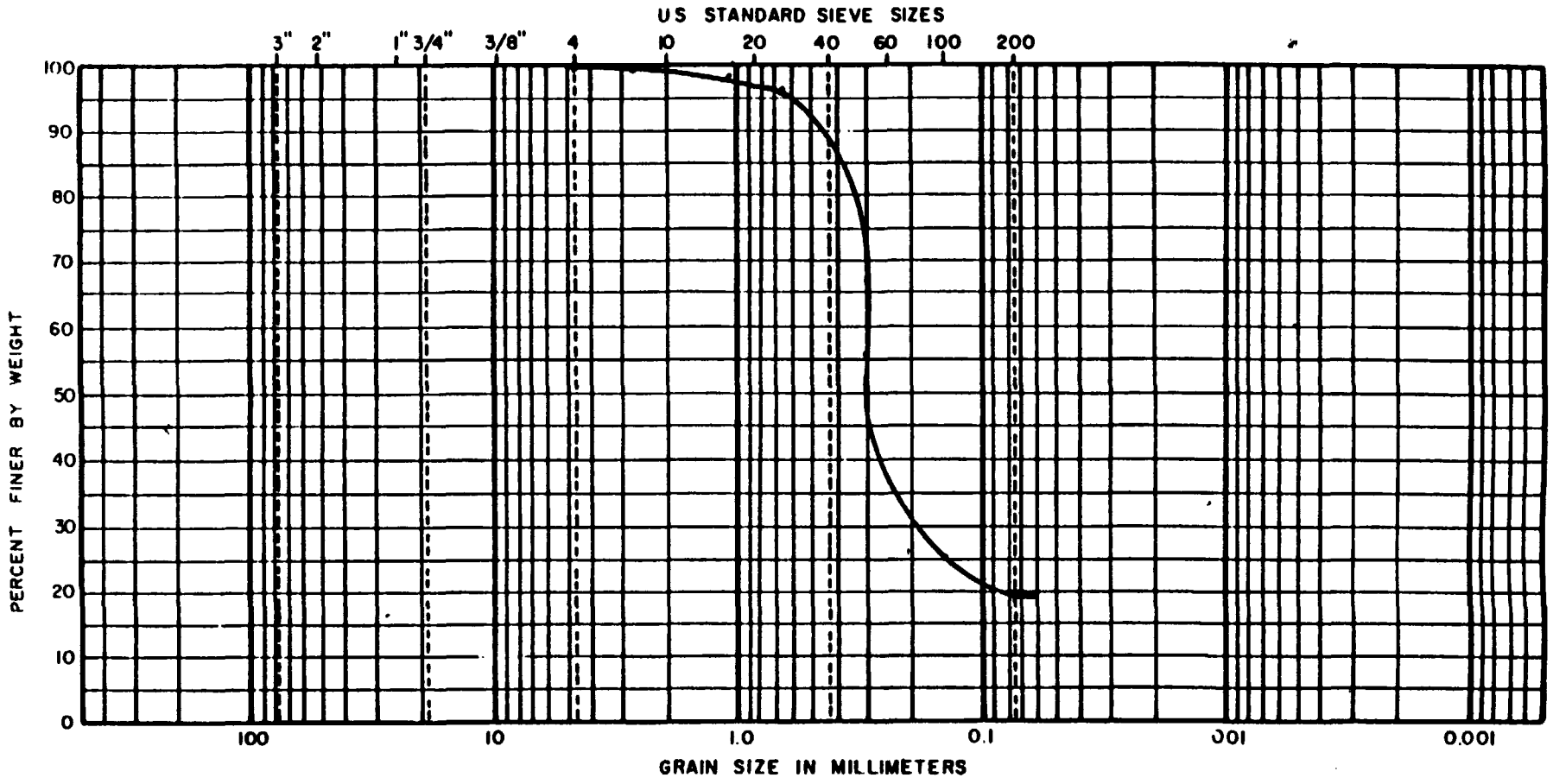

| BOULDERS | COBBLES | GRAVEL | | SAND | | | FINES | |
|---|---|---|---|---|---|---|---|---|
| | | COARSE | FINE | COARSE | MEDIUM | FINE | SILT SIZES | CLAY SIZES |

| | | |
|---|---|---|
| BORING NO. | Bag Sample 2 | DESCRIPTION OR CLASSIFICATION |
| DEPTH OR ELEV. | | Medium Brown Slightly Clayey Sand |
| MOISTURE % | 9.6 | |
| LIQUID LIMIT | | |
| PLASTIC LIMIT | | |
| PLASTICITY INDEX | | |

# GRAIN SIZE DISTRIBUTION

JOB NO. 705.87.502

LAW ENGINEERING TESTING COMPANY




| BOULDERS | COBBLES | GRAVEL | | SAND | | | FINES | |
|---|---|---|---|---|---|---|---|---|
| | | COARSE | FINE | COARSE | MEDIUM | FINE | SILT SIZES | CLAY SIZES |

| | | |
|---|---|---|
| BORING NO. | Bag Sample 3 | DESCRIPTION OR CLASSIFICATION |
| DEPTH OR ELEV. | | Medium Brown Slightly Clayey Sand |
| MOISTURE % | 9.6 | |
| LIQUID LIMIT | | |
| PLASTIC LIMIT | | |
| PLASTICITY INDEX | | |

# GRAIN SIZE DISTRIBUTION

JOB NO. 705.87.502

LAW ENGINEERING TESTING COMPANY

# APPENDIX B

# FINAL DESIGN

Project Identification
No. E-4236

REM III EPA Contract
No. 68-01-7250

EBASCO SERVICES INCORPORATED, ENGINEER

EBASCO SPECIFICATION E-4236-C-1

# EARTHWORK

PURCHASER: ENVIRONMENTAL PROTECTION AGENCY

OWNER: ENVIRONMENTAL PROTECTION AGENCY

PROJECT: LEE'S LANE LANDFILL

LOCATION: JEFFERSON COUNTY, KENTUCKY

Prepared under the supervision of

G. A. Kanakaris

Date: 6/25/87

Kentucky PE License No. 13394


On acceptance of an Order involving this specification, the Contractor is understood to have accepted complete responsibility for engineering, design, workmanship, material, performance of equipment and material and all other obligations under the Order and for the supply of equipment which will provide the performance specified.

| Spec Status | Date | Prepared By | Reviewed By | Approved By | Pages Affected |
|---|---|---|---|---|---|
| Original | 06-24-87 | H. Koeplin | K. Kessler | M. A. Szomjassy | |
| R1 | 09-24-87 | H. Koeplin | K. Kessler | M. A. Szomjassy | 1, 1 |
| R2 | 12-01-87 | H. Koeplin | K. Kessler | M. A. Szomjassy | 6 |

1.0 SCOPE

1.1.1 General - This specification covers the technical requirements for clearing and grubbing. The Contractor shall perform high quality construction work meeting the requirements of this specification.

1.1.2 Definitions - The term "Engineer" shall mean Ebasco Services Incorporated and the term "Contractor" shall mean the organization contracted by the Environmental Protection Agency to perform site work. The term "Owner" shall mean the Environmental Protection Agency.

1.1.3 Work to be Performed by Contractor - The Contractor's work shall consist of clearing and grubbing to the extent indicated on drawings.

The Contractor shall exercise extreme care to preserve and avoid damage to trees, shrubs and other vegetative cover in areas outside the clearing and grubbing limits, and shall not enter any of these areas without prior written consent.

The Contractor's work also shall include erosion and sediment control as necessary to protect the Ohio River and surrounding environment.

1.1.4 Work to be Provided by Engineer - Erosion and Sediment Control Technical Specification 2.0, "Erosion and Sediment Control."

1.2 REFERENCES

1.2.1 General - The services provided and equipment used in the performance of the work described by this specification shall comply with the State and local ordinances, including those relating to the prevention of forest fires.

1.2.2 Project Drawings

| | | |
|---|---|---|
| Location Map | Drawing E-4236-D-1 - Sheet 1 of 7 | R1 |
| Site Plans | Drawing E-4236-D-1 - Sheet 2, 3 & 4 of 7 | |

1.3 MATERIALS (None)

1.4 TECHNICAL REQUIREMENTS

1.4.1 General - All clearing, grubbing, and handling of debris shall proceed in a manner to avoid interference with other work in progress.

1.4.2 The term "Clearing and Grubbing" shall mean the complete removal and disposal of all standing trees including their root systems along with all brush, bushes, shrubs, stumps, vines and their associated

root systems, as well as any deadfalls, trees cut by others, wood fencing, wood structures, and other wood debris and any man-made objects such as concrete blocks, rubber tires, etc. in the areas to be cleared and grubbed.

1.4.3 Description of Services - The Contractor shall provide all items of labor and equipment necessary to perform the work of clearing and grubbing.

The Contractor may employ any practical means for performing the work, including such equipment as tractors and chains, bulldozers with brush hooks or rakes, or ax and chain saw, such that the specified requirements for clearing and grubbing are accomplished.

When bulldozers can be used in areas to be cleared and grubbed, the Contractor shall, wherever possible, push or pull over trees, extracting roots all in one piece.

All grubbing holes and depressions resulting from tree root and stump removals shall be backfilled and compacted by track-walking until no further settlement is noted under the equipment weight, and graded to conform to the surrounding ground contours. Piles of soil resulting from stump removal shall be levelled by rough-grading. No materials from the designated contamination zone (site boundaries) shall be moved outside the contamination zone without approval of the USEPA.

1.4.4 Erosion and Sediment Control - Control of erosion from disturbed, cleared, or cleared and grubbed areas may involve the use of ditches, dikes, hay bales, silt screens, small sedimentation ponds or any other practical means to minimize sediment discharge t the Ohio River or natural channels outside the areas being worked. The installation of such control devices shall be the sole responsibility of the contractor. The erosion and sediment control will be as per the plan approved by the Engineer and in accordance with Technical Specification 2.0, "Erosion and Sediment Control."

## 1.5 ENGINEER'S OBSERVATIONS

The Engineer shall observe the clearing and grubbing operations and record the observations of such activities in field log books for the purpose of developing the Operations and Maintenance plan. Any deviations from the specifications will be reported to the Contractor and the Owner for repair.

# TECHNICAL SPECIFICATION

## 2.0 Erosion and Sediment Control

2.1 SCOPE

2.1.1 General - This specification covers the technical and other requirements for controlling erosion and limiting sediment discharge of turbid runoff water from the site during construction operations on the project.

2.1.2 Definitions - The term "Engineer" shall mean Ebasco Services Incorporated and the term "Contractor" shall mean the organization contracted by the Environmental Protection Agency to perform site work. The term "Owner" shall mean the Environmental Protection Agency.

2.1.3 Work to be Provided by the Contractor - The Contractor's work shall include, but not necessarily be limited to, the construction and maintaining of berms, ditches, traps, impermeable liners, silt fences and other erosion and sediment control measures; preparation of slopes; and cleanup and phase-out of the erosion and sediment control measures upon completion of remedial construction activities.

2.2 REFERENCES

2.2.1 General - Services furnished shall be in accordance with the codes and standards listed in Paragraphs 2.2.2 and 2.2.3. Later editions may be used by mutual consent in writing between Contractor and Engineer. In addition to the above codes and standards, Contractor shall comply with the State or local ordinances, laws and regulations.

2.2.2 Listing

EPA - Environmental Protection Agency

EPA-430/9-73-007 - Processes, Procedures and Methods to Control Pollution Resulting From All Construction Activity

Federal Regulations

Section 402 of the Federal Water Pollution Control Act - Amendments 1972

40 CFR 423, Subpart D - Area Runoff Subcategory

2.2.3 Project Drawings

| | | |
|---|---|---|
| Location Map | Drawing E-4236-D-1 - Sheet 1 of 7 | R1 |
| Site Plans | Drawing E-4236-D-1 - Sheet 2, 3 & 4 of 7 | |

2.3 MATERIALS

2.3.1 Ditch Lining - Drainage ditches as required by the Owner shall be lined with impermeable liner as approved by the Engineer. The liner shall contain no fillers, extenders or any detrimental additives.

2.3.2 Silt Fences - Drainage ditches as required by owner shall be constructed with silt fence barriers placed at 500 foot spacings across the ditch. Silt fences shall be constructed using commercially available fence posts and Mirafi 140 filter fabric or approved alternates.

2.3.3 Sediment Traps - Sediment traps constructed of bales of straw or (hay) or Mirafi 140 or substitute shall be constructed as required to trap sediment.

2.4 Description of Services

2.4.1 Contractor shall provide all labor, equipment and materials necessary to construct erosion and sediment control measures to control erosion and limit sediment discharges from construction operations. Such measures shall include the construction of temporary berms, diversion ditches, dike checks and sediment structures (traps, silt fences, impermeable liners), and the use of mulches, mats, seeding or other control measures as necessary.

2.4.2 Contractor shall incorporate all control measures at the start of construction operations in accordance with this specification or as directed by the Owner. Temporary control measures shall be used to correct conditions that develop during construction operations and have not been foreseen during the design stage; that are needed prior to the installation of the design control measures, or that are needed temporarily to control erosion and limit sediment discharges that develop during normal construction practices but are not associated with the design control measures of the project.

2.4.3 The Contractor shall comply with the design drawings and intent of this specification to prevent water pollution to the maximum extent possible.

2.4.4 The Contractor shall make every effort to minimize erosion from clearing and grubbing, and excavation, including, but not limited to the following:

2.4.4.1 No materials from the designated contamination zone (site boundaries) shall be moved outside that zone.

2.4.4.2 Construction of temporary berms, dikes, and diversion ditches to prevent runoff of contaminated rainwater to the Ohio River and prevent clean runoff from entering contaminated portions of the site. Runoff, as defined in this specification, is that portion of the precipitation on a drainage area resulting from the rainfall smaller than the 10-year, 24-hour rainfall event which is discharged from that area via surface drainage.

2.4.4.3 Use of extreme caution to limit disturbances of natural areas to the absolute minimum required.

2.4.4.4 Sequencing of clearing and grubbing and excavation to maintain natural traps for eroded material and any other measures effective in minimizing erosion and limiting sediment discharge.

2.4.4.5 Excavation from any source shall be stockpiled in the designated areas as directed by the Owner.

2.4.4.6 Providing of bales of straw (or hay) to trap sediment where required. Silt fences constructed of Mirafi 140 filter fabric or equal with supporting fence poles shall be provided across the drainage ditches at an interval of every 500 feet.

2.4.5 Drainage ditches shall be lined as directed by the Owner, with impermeable liner containing no fillers, extenders or any detrimental additives. The panel size of the liners shall be so designed to minimize field cutting and number of seams in the installation.

2.4.5.1 The physical properties of the liner shall conform to ASTM standards. The Contractor shall be responsible for inspection of the sheet rolls at arrival at the job site. Any faulty areas shall be repaired in a manner approved by the Owner.

2.4.5.2 Liner sheet field joints shall be made by overlapping adjacent sheet as recommended by the liner manufacturer.

2.4.6 Maintenance

2.4.6.1 The Contractor shall maintain all areas to the acceptance of the Engineer. All areas shall be protected from equipment traffic and any damaged areas shall be repaired promptly.

2.4.6.2 The Contractor shall repair, replace and clean out all erosion and sediment control traps, ditches and facilities promptly. All erosion and sediment control silt fences, shall be cleaned whenever the sediment depth reaches approximately six inches. The sediment removed shall be placed in the contaminated soil spoil areas as directed by the Owner.

2.4.6.3 The Contractor shall be fully responsible for repair and maintenance of the integrity of the synthetic liners whenever they are utilized during the life of this project.

2.4.7 Phaseout

Erosion and sediment control measures and structures, shall be phased-out upon completion of the construction work and the stabilization of the drainage areas. Any standing water, siltation, silt fences, and liners shall be removed from drainage ditches prior to regrading.

2.5 ENGINEER'S CONTROL

a) The Engineer shall observe the erosion and sediment control activities and record the observations of such activities in field log books. Any deviations from the specifications will be reported to the Contractor and Owner for repair.

# TECHNICAL SPECIFICATION

## 3.0 Excavation, Backfill, Filling and Grading

## 3.0 SCOPE

### 3.1 General

3.1.1 This specification covers the technical and other requirements for excavation, backfill, filling and grading.

3.1.2 It is not the intent of this specification to outline all the technical requirements nor to set forth those requirements adequately covered by applicable codes, specifications and standards. Contractor shall perform high quality construction work meeting the requirements of this specification and industry standards.

3.1.3 The term "Engineer" shall mean Ebasco Services Incorporated and the term "Contractor" shall mean the organization contracted by the Environmental Protection Agency to perform site work. The term "Owner" shall mean the Environmental Protection Agency.

3.1.4 Contractor shall make every effort to minimize erosion from excavation, backfill, filling and grading.

3.1.5 Contractor shall use extreme caution to limit disturbances of natural areas to the absolute minimum required.

3.1.6 Contractor shall sequence his work of excavation, backfill, filling and grading to maintain natural traps for eroded material and any other measures effective in minimizing erosion and limiting sediment discharge.

3.1.7 Contractor shall maintain all areas for the acceptance by the Engineer. All areas shall be protected from equipment traffic and any damaged areas shall be repaired promptly.

3.1.8 In the event that charged overhead electrical transmission lines which may constitute a hazard are in the working areas, Contractor shall take due precautions in conducting operations in these areas and shall advise Owner of Contractor's schedule and any special requirements at least ten (10) days in advance of the work. The location of any underground utilities in the work area will be indicated on design drawings as representing best information available.

3.2 Work to be Provided by Contractor

3.2.1 Contractor's work shall include, but not necessarily be limited to, providing all items of labor, material and equipment necessary to perform the work of excavation, backfill, filling and grading.

3.2.1.1 Storage or disposal of all earth, sand, gravel, rock, boulders, debris and/or other materials in the spoil area or at such other locations shall be as directed by Owner. No materials from the designated contamination zone (site boundaries) shall be moved outside that zone.

3.2.1.2 Supplying, installing, maintaining and removing any wooden or metal sheeting, bracing and/or shoring required for the safe and acceptable performance of the work.

3.2.1.3 Maintenance of all excavations during construction, including erection and maintenance of substantial barricades around excavations where required for safety.

3.2.1.4 Care, diversion and removal of all surface water, rainwater or groundwater seeping or flowing into the excavations by means of ditching, damming, pumping or other suitable means deemed acceptable to the Engineer.

3.2.1.5 Backfilling of all unauthorized overexcavations.

3.2.1.6 Contractor's work shall include furnishing and installing filter bedding sand, manufactured sand, geotextile filter fabric, crushed stone aggregate, rip-rap and all related items as shown on the design drawings and specified herein.

3.2.2 Contractor shall divert, collect and store all surface water, rainwater or ground water seeping or flowing away from the site by means of ditching, damming, pumping or other suitable means. All collected water shall be drained or disposed of as directed by the Owner (for reference see Paragraph 1.2.5).

3.2.3 No major dewatering work is anticipated for the project, since all the excavation will be performed above the ground water table. The only minor dewatering to be performed for the project will consist of the diversion of surface runoff.

3.2.4 Contractor shall provide all necessary equipment such as pumps, sumps, suction and discharge lines, and other dewatering system equipment and labor necessary to keep the construction areas in the dry.

3.2.5 Contractor shall provide treatment of water emanating from or flowing through, or over cleared, grubbed and excavated areas, or storage/disposal sites, when such water is contaminated or otherwise deemed unsuitable for discharging in accordance with local, state or federal regulations, or as designated by Owner. Owner shall be responsible for testing of such water for characterization. The Contractor shall be responsible for conveying the accumulated water from any depression, and/or excavation areas to the erosion control ditches after treatment.

3.2.6 Contractor shall provide erosion and sediment control structures for the various slopes as designated by the Owner. Contractor shall employ ditches, dikes, hay bales, silt screens, or any other means, acceptable to Engineer, to minimize sediment yield to the Ohio River, natural streams and channels outside of areas being worked. (See 2.0 "Erosion and Sediment Control" Specification Section 2.4.1 and 2.4.2.)

3.3 Work to be Provided by Owner

3.3.1 Owner's work will include the providing of design drawings, if design is by Engineer, indicating the limits of excavation, backfill, filling and grading, and the installation of base lines and bench marks. Owner will also perform field control tests to verify density, moisture content and gradation of fill material, as required.

3.4 CODES, SPECIFICATIONS AND STANDARDS

3.4.1 General

Material and services furnished in accordance with this specification shall comply with the codes, specifications and standards. Later editions may be used by mutual consent in writing between Contractor and Owner.

3.4.2 Any conflict between this specification and the referenced codes, specifications and standards shall be immediately brought to Engineer's attention for written resolution.

3.5 Listing

EPA - Environmental Protection Agency
EPA - 430/9-73-007 - Processes, Procedures and Methods to Control Pollution Resulting From All Construction Activity

ASTM - American Society for Testing and Materials

D1140-71 Standard Test Method for the Amount of Material in Soils Finer than the No. 200 (.074-mm) Sieve

OSHA - Occupational Safety and Health Administration

Regulation 29 CFR Part 1926 - Occupational Safety and Health Regulations for Construction (October 1, 1979)

3.6 TECHNICAL REQUIREMENTS

Excavation

Excavation shall consist of the removal, storage and/or disposal of all materials required to be removed, such as topsoil, vegetation, tree stumps, clay, sand, gravel, rock fragments, boulders, soft and disintegrated rock, trash, or any other unsuitable material that can be effectively removed.

3.6.1 Excavation shall be performed to the lines, grades and slopes shown on design drawings and as required to permit placement of filter sand, geotextiles, crushed stone and rip-rap. The steepest slope shall be 3.5 horizontal to 1 vertical.

3.6.2 Slopes of all excavations shall be cut true and straight, and all loose trash, stones, boulders, roots, stumps and unstable ground in the slopes shall be removed.

3.6.3 Variations of depth, width and length of excavation, or increase and decrease of excavation slopes from those shown on design drawings shall be accepted by Engineer in writing.

3.6.4 All erosion and sediment control facilities for the various excavation and spoil areas shown on design drawings shall be coordinated with and constructed prior to starting other work.

3.6.5 During the course of any excavation work, located in areas beyond the clearing and grubbing lines as designated by the Engineer, extreme care shall be exercised to preserve and avoid damage to trees, shrubs and all other vegetation that will not directly hamper work progress.

## 3.7 Overexcavation

Whenever material is excavated beyond the area designated by the Engineer, Engineer will direct that such overexcavation be backfilled with random fill material from the site, or purchased material. Sources shall be subject to Engineer's acceptance.

## 3.8 Disposition of Excavated Material

Immediately after grubbing and before general excavation commences, topsoil shall be completely stripped in areas to be excavated. If excavation is not required on the river bank slopes, the topsoil may be left in place. Topsoil is defined as the surface or top layer of soil including fine roots, herbaceous vegetation and overlaying grass, and is characterized by the presence of organic matter.

3.8.1 Topsoil shall be stockpiled at locations designated by the Owner, shaped to a smooth outline, and compacted by two (2) or three (3) passes of the hauling and spreading equipment.

3.8.2 Material shall be classified and segregated during the excavation and shall be placed directly in final locations or in temporary stockpiles and later placed in the designated final locations in accordance with design drawings or as designated by Owner.

Insofar as it is practicable, all suitable materials resulting from excavations shall be used for shaping, grading and construction. Where practicable, materials suitable for use for construction shall be excavated separately from materials to be spoiled.

3.8.3 Excavated materials which are unsuitable for use in accordance with this specification and design drawings or which are spoil or excess material not required for construction shall be disposed of as designated by Owner. No material from the designated contamination zone (site boundaries) shall be moved outside the contamination zone. Spoil areas shall be brought to smooth lines and shaped to ensure drainage.

All waste material shall be disposed of in a manner which will avoid the necessity for rehandling or interference with other work. It shall be

spread and graded in uniform layers and compacted by a minimum of four (4) passes by self propelled wedgefoot rollers or other equipment acceptable to Engineer.

## 3.9 Backfill

Every effort shall be made to place backfill material symmetrically and in uniform layers. Where a large number of lifts are required to complete a backfill operation and the elapsed time between placements is large, the surface of each lift should be sloped to facilitate drainage.

3.9.1 All necessary processing, including raking, crushing, removal of oversize material, mixing, and watering or aerating shall be performed in the stockpile area.

## 3.10 Materials For Erosion Protection

Materials for erosion protection used at any location shall be those shown on design drawings, and shall conform to the following requirements:

### 3.10.1 Filter Bedding Sand

The sand shall be free of organic matter, rubbish, debris, or other unsuitable materials, and shall have no more than 5 percent of the material passing the No. 200 sieve in accordance with ASTM D1140. In addition, no more than 35 percent by weight larger than No. 4 sieve shall be retained. The maximum allowable size of material shall be 3/8 inches, and the following additional requirements shall be adhered to:

| Size | Percent Passing | |
|---|---|---|
| 1/2 inch | - | R2 |
| 3/8 inch | 100 | |
| No. 4 | 98-100 | |
| No. 8 | 95-100 | |
| No. 16 | 93-98 | |
| No. 30 | 85-95 | |
| No. 50 | 40-85 | |
| No. 100 | 15-25 | |
| No. 200 | 10-20 | |

3.10.2 Manufactured Sand

The manufactured sand shall be free of organic matter, rubbish, debris or other unsuitable materials, and shall have no more than 5 percent of the material passing the No. 200 sieve in accordance with ASTM D1140. The maximum allowable size of material shall be 3/8 inches, and the following gradation requirement shall be adhered to:

| Size | Percent Passing |
|---|---|
| 3/4 inch | 94-99 |
| 3/8 inch | 87-92 |
| No. 4 | 37-42 |
| No. 20 | 12-17 |
| No. 40 | 5-10 |
| No. 100 | 3-8 |
| No. 200 | 0-5 |

3.10.3 Geotextile

The filter fabric shall be a synthetic non-woven geotextile similar to Mirafi #140 or approved alternate. The material shall be a 100% polyester filament fabric, mechanically bonded, weighing approximately 5.0 oz/sq yd. The material shall have sufficient tensile strength, provide permeability, soil retention and separation, conformability, lateral restraint, maintaining drainage and waterflow, resist soil chemicals and ultraviolet light exposure.

3.10.4 No. 3 Stone shall be obtained from hard, durable and clean rock, and shall have no more than 15 percent of material smaller than one-half (1/2) inches. The maximum allowable size of material shall be two (2) inches, and shall meet the following gradation requirement:

| Size | Percent Passing |
|---|---|
| 2-1/2 inch | - |
| 2 inch | 95-100 |
| 1-1/2 inch | 35-70 |
| 1 inch | 0-15 |
| 1/2 inch | 0-10 |

3.10.5 Rip-rap shall be obtained from hard, durable and clean rock and shall consist of quarry run stone. The size of rip-rap shall be uniformly graded from a maximum size of eight (8) inches to a minimum size of four (4) inches and the fifty (50) percent size of five (5) to five and one-half (5-1/2) inches.

3.10.6 Random Fill material shall be uncontaminated material free of stumps, roots, brush, rubbish, organic topsoil and other objectionable material. While no specific requirements covering type, gradation, moisture content or size limitation for this material are presented herein, sources shall be subject to Engineer's acceptance.

3.10.7 Spoil Fill material shall consist primarily of material secured by stripping the topsoil and vegetative material from excavated areas on the plant site. (See 1.0 "Clearing and Grubbing" Specification.)

## 3.11 Certificate of Compliance

Contractor shall furnish a Certificate of Compliance stating that all work and materials furnished comply with this specification and any accepted deviations that may arise and is agreed upon during construction.

## 3.12 INSTALLATION

Contractor's construction services shall be in accordance with the applicable provisions of OSHA Regulation 29 CFR Part 1926.

### 3.12.1 General

When the weather is such as to endanger the quality of the fill material being placed, be this due to rain or any other weather element, the placement of material shall be halted until weather conditions are satisfactory. Under no conditions shall fill be placed during heavy rains.

No materials shall be placed while frozen nor shall any material be placed on frozen surfaces.

The area to be filled shall be prepared by proof rolling with a minimum of four passes of a self propelled wedge foot roller having a minimum static weight of 20 tons.

The random fill material shall be spread and leveled in layers not exceeding 12 inches in thickness before compaction.

The Contractor shall uniformly grade the areas within the limits shown on the design drawings, including adjacent transition areas, and smooth the finished surfaces.

3.12.2 Filter Bedding Sand

The area to be backfilled or filled shall be prepared by grading and shaping and by compacting the material in place on slopes and other placement areas with equipment track walking a minimum of four (4) passes, or a self propelled wedge foot roller having a minimum static weight of 20 tons, or until accepted by Engineer.

The filter bedding sand material shall be placed in two (2) equal lifts. The first lift shall be spread and graded before compaction and shall be compacted with a minimum of four (4) passes of a self propelled wedge foot roller having a minimum static weight of 20 tons or until accepted by Engineer. The second layer shall be spread and graded and compacted by a minimum of four (4) passes of equipment (bulldozer) track walking or until accepted by Engineer.

3.12.3 Manufactured Sand

Placement and compaction of manufactured sand fill shall be prepared by grading and shaping and by compacting the material in place on slopes and other placement areas with equipment track walking a minimum of four (4) passes.

3.12.4 No. 3 Stone

After placement of the filter fabric the aggregate shall be deposited as uniformly as possible.

The aggregate shall be placed directly on the filter fabric and graded as required.

Installation and compaction of crushed stone fill may be performed by the passage of dozers or by surface vibrators, smooth rollers, power tampers or other equipment acceptable to Engineer.

Where compaction of crushed stone backfill is performed by portable equipment, the material shall be deposited in horizontal layers and compacted to a stable condition.

3.12.5 Rip-rap

Rock for rip-rap shall be placed on a No. 3 stone filter blanket in a manner to produce a reasonably well-graded mass of rock with the minimum practicable percentage of voids and without pockets of small rock and clusters of large rock.

When rip-rap is provided in a single operation it shall be placed to the full slope thickness indicated on design drawings in one operation and in a manner to avoid displacing the underlying materials.

3.12.6 Geotextile

Prior to the placing of the filter fabric the manufactured sand shall be cleared of any protruding objects, boulders, large rocks and debris and shall be shaped and compacted.

Geotextile shall be placed in strict accordance with manufacturer's instructions on prepared stable and graded slopes or surfaces.

The fabric shall be anchored and staked with securing pins. Joints shall be overlapped a minimum of 18 inches and secured in accordance with the instructions.

3.12.7 Random Fill

Random fill shall be placed carefully so as not to disturb previously placed backfill of any type.

All material shall be deposited and graded so that gravel, cobbles and boulders will be well distributed and not concentrated in pockets or in any one layer.

Where random fill is to be placed over ground a series of open furrows shall be formed not less than eight (8) inches deep below the ground at intervals of not more than three (3) feet. Sloping ground shall be furrowed or stepped.

3.12.8 Spoil Fill

Spoil fill shall be compacted by two (2) or three (3) passes of the hauling equipment and shall be leveled to grade by scraping. Provisions shall be made for drainage.

3.12.9 Phaseout

Erosion and sediment control measures and structures, shall be phased-out upon completion of the construction in accordance with the Technical Specification 2.0 "Erosion and Sediment Control."

3.13 ENGINEER'S OBSERVATIONS

The Engineer shall observe the excavation, backfill, filling and grading operations and record the observations of such activities in field log books for the purpose of developing the Operations and Maintenance Plan. Any deviations from the specifications will be reported to the Contractor and the Owner for repair.

# OVERSIZED

# DOCUMENT

8